CALIFORNIA SEWAGE WORKS JOURNAL

Official Publication of the California Sewage Works Association

Vol. XIV 1942 No. 1

Minutes of Fourteenth Annual Fall Convention At Sacramento, California, October 12-14, 1941

★

Revision of Constitution

★

The Evaluation of Industrial Wastes in the East Bay

★

Sewage Disposal Practice at Military Establishments in California

★

The Evaluation of Sewage Treatment

★

Better Methods for the Determination of Grease

★

The Design of Sewage Treatment Plants from the Standpoint of Defense Ratings and Materials Available

★

Operators' Symposium

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CALIFORNIA SEWAGE WORKS JOURNAL

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Federation of Sewage Works Associations

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California Sewage Works Journal

Published by CALIFORNIA SEWAGE WORKS ASSOCIATION

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ANNOUNCEMENT

Fourteenth Annual Spring Meeting
California Sewage Works Association

Bakersfield, California

APRIL 26-28, 1942

Sunday Evening, April 26

Registration and dinner followed by operator's symposium.

Monday, April 27

Separate breakfasts for Directors, Operators and Chemists. A short business meeting will preface the morning session at which time several members will discuss major disaster plans in case of possible bombing of sewerage works. Mr. W. H. Wisely, Secretary, Federation of Sewage Works Associations, will discuss interesting features of sewage plants in the Middle West.

A paper on cannery wastes treatment will be presented by Earl M. Kelly, Sanitary Engineer, Dorr Co.

In the afternoon members and guests will visit a number of the Kern county sewage treatment plants.

At the banquet on Monday evening the guest speaker will be a high ranking officer of the U. S. War Department. Army camp sanitation will be his subject.

Tuesday, April 28

Dr. Richard Pomeroy, consultant chemist, will present a paper on sulfide control. Chief operators of the Kern county treatment plants will discuss their operating problems.

Adjournment at noon.

FOURTEENTH ANNUAL FALL CONVENTION
CALIFORNIA SEWAGE WORKS ASSOCIATION

Sacramento, California
October 12-14, 1941

MINUTES OF THE MEETING

Sunday, Oct. 12

OPERATORS' SYMPOSIUM

President Harold F. Gray called the Convention to order at 2:30 P. M. at the Hotel Sacramento with fifty-two members present. President Gray announced that the program for the afternoon was to be a symposium on various operating problems with open discussion. As Mr. R. R. Sotter, Chairman of the Operators' Symposium, could not attend the Convention President Gray turned the meeting over to F. Wayland Jones, Vice-Chairman of that Committee.

An interesting and informative discussion was held on the following subjects: Plant Records; Methods Used in Disposing of Rags and Screenings; Handling Dry Sludge from Plant; Beautification of Plants and Grounds; Odor Control of Plant; Personal Safety; Plant Safety, and Methods Used in Taking Samples.

OPERATORS' BUFFET DINNER

An attractive buffet dinner was served to sixty-two Operators, other members and guests, at Hotel Sacramento, following which President Gray announced that Mr. William T. "Bill" Ingram, Secretary-Treasurer of the Association for the past two years, taking advantage of an opportunity to attend Johns Hopkins University, was forced to resign on August 16, 1941. The Association certainly owes "Bill' appreciation for his efficient and untiring work as Secretary-Treasurer. Mr. Gray stated that the present Secretary-Treasurer had been appointed with approval of the Governing Board on August 20, 1941. President Gray introduced the new Secretary to all those present in his own humorous way.

Monday, Oct. 13

CARAVAN

The Caravan was assembled at 9:15 A. M. by Carl M. Hoskinson, Chairman of the Local Arrangements Committee, with thirty-five cars in all. The Treatment plants for the Cities of Roseville and Auburn were visited in the morning. The Caravan stopped for lunch at the historic Hotel Freeman in Auburn. The treatment plant for McClelland Field was the next stop. Before leaving the members were treated to a tour around the field. The Caravan then proceeded to the Dixon sewage plant, and later visited Sump No. 2, Pumping

Plant of the City of Sacramento where the Caravan disbanded at 5:30 P. M.

ANNUAL BANQUET

Some 150 members and guests assembled at the Hotel Senator at 7:30 P. M. with President Gray presiding. Members of the Department of Public Health Officials, League of California Cities had been invited and a good number were in attendance. President Gray had as his personal guests Dr. Lee A. Stone, President of the Health Officials, and Mr. Louis Olsen, Health Officer, City of Palo Alto. The guest speaker of the evening was Dr. C. A. E. Winslow, Professor of Public Health, Yale University. Dr. Winslow's subject, "The Past and Future of the Public Health Movement," was much enjoyed by all those present.

Tuesday, Oct. 14

JOINT BREAKFAST

A joint breakfast with the Public Works Officers' Department of the League of California Cities, was held at 7:00 A. M. at the Hotel Senator with a total of thirty-nine in attendance. Mr. Ed. A. Hoffman, President of the Public Works Officers, presided. President Gray presented a humorous sequel to his paper "Sewage in Ancient Mediaeval Times" which he had presented at the Twelfth Annual Spring Conference at Avalon in 1940.

JOINT MEETINGS — PAPERS

President Gray called the joint meeting with the Public Works Officers to order at 9:10 A. M. in the Little Theater of the Memorial Auditorium. Mr. Roy E. Ramseier, Sanitary Engineer, City of Richmond, presented a paper entitled "Methods of Evaluating the Industrial Wastes Problems of an Area, as Exemplified in the East Bay Sewage Disposal Survey." The following persons, Paul A. Shaw, Cedric L. Macabee, and A. A. Appel, discussed his paper.

"Sewage Disposal Practice at Military Establishments in California," prepared by E. A. Reinke, Senior Sanitary Engineer, and J. W. Pratt, Assistant Sanitary Engineer, Bureau of Sanitary Engineering, State Department of Public Health, was presented by Mr. Pratt.

Mr. Reinke stated that it was impossible to compare efficiencies of the various plants at the present time because the recirculation rates varied from 10 to 70 million gallons per acre per day, and that the B.O.D. loading varied from 0.1 to 3.0 pounds per cubic yard per day.

Mr. W. J. O'Connell, Jr., Research Engineer, Wallace & Tiernan Sales Corporation, presented a paper, "The Evaluation of Sewage Treatment." Considerable discussion followed. (A summary of this follows his printed article in this Journal.)

Mr. F. Carlisle Roberts, Sanitary Engineer, presented a paper, "The Design of Sewage Treatment Plants from the Standpoint of Defense Ratings and Materials Available." A dissertation by Mr.

Phelps in his own inimical manner on the problems which have confronted San Diego in their sewer construction program concluded a lively discussion.

The meeting was adjourned at 12:00 noon.

President Gray reconvened the meeting at 1:30 P. M. Mr. Harvey F. Ludwig, Sanitary Engineer, presented the last paper of the session entitled "Better Methods for the Determination of Grease in Sewage." Messrs. Baugh, Pomeroy and Parks participated in the discussion.

BUSINESS MEETING

President Gray opened the business meeting at 2:10 P. M., with forty-four members present. Mr. R. D. Woodward submitted the following report for the nominating committee:

President—Fred D. Bowlus.
First Vice-President—Carl M. Hoskinson.
Second Vice-President—Richard D. Pomeroy.
Secretary-Treasurer—Jack H. Kimball.
Director, 1946—Wm. J. O'Connell.

The officers as nominated were elected.

The following Committee reports were given:

Membership, Jack H. Kimball; Financing Journal, J. F. Smith; Publicity, F. Wayland Jones; Secretary-Treasurer, Wm. T. Ingram; Auditing, B. Benas; Award, A. J. Castro, Jr.; San Joaquin Local Section, F. Wayland Jones; Certification, R. L. Derby; School for Operators, R. L. Derby; Design Practice, Richard D. Pomeroy; Safety Standards, F. S. Currie; Industrial Wastes, W. T. Knowlton.

W. A. Allen, Chairman of the Committee on Resolutions, read the following resolutions:

RESOLUTION I

"WHEREAS: The California Sewage Works Association has lost by death on April 30, 1941, our beloved member A. Carl Beyer, who has rendered inestimable service to this Association, and who endeared himself to our members through his fine character and personality: now therefore:

"BE IT RESOLVED: By the members of the California Sewage Works Association in convention assembled at Sacramento, California, this 14th day of October, 1941, that we have sustained an irreparable loss of one who was constantly of the greatest service to us all, and that we direct that a copy of this resolution be spread upon the minutes of this meeting, and a copy hereof be sent to his widow with our condolences for her great loss."

RESOLUTION II

"WHEREAS: The California Sewage Works Association has lost by death on August 15, 1941, our beloved member and Past President John Jacobson, who has rendered valuable service to our Association not only during his term of office as President but also during the formative period of the California Sewage Works Association, and who endeared himself to our members by his loyalty to the Association and his fine character: now therefore

"BE IT RESOLVED: By the members of the California Sewage Works Association in convention assembled at Sacramento, California, this 14th

day of October, 1941, that we have sustained an irreparable loss of one who contributed much to the success of the Association, and that we direct that a copy of this resolution be spread upon the minutes of this meeting, and a copy hereof be sent to his widow with our condolences for her great loss."

RESOLUTION III

"WHEREAS: It has been demonstrated that the results from the operation of the State Department of Public Health traveling sewage works laboratory will be of great value in obtaining impartial and accurate information on plant operating results, and

"WHEREAS: The continued operation of this equipment will materially assist in better sewage plant performance, resulting in improved public health conditions; now therefore

"BE IT RESOLVED: That the State Department of Public Health be requested to continue and if possible enlarge this activity.

"BE IT FURTHER RESOLVED: That this Association express to the Fish and Game Commission our appreciation for their splendid cooperation and efforts in reducing pollution of the waters of California.

"BE IT FURTHER RESOLVED: That a copy of this resolution be spread upon the minutes of this meeting and that the secretary be directed to send copies hereof to the State Department of Public Health and to the Fish and Game Commission."

RESOLUTION IV

"WHEREAS: The California Sewage Works Association has had a very successful convention in Sacramento, California, October 12-14, 1941; now therefore

"BE IT RESOLVED: That this Association express its thanks and appreciation to the committee on Local Arrangements, under the chairmanship of Carl M. Hoskinson, to the Officials of the City of Sacramento, California, to the Chamber of Commerce of Sacramento, California, and all others who have participated in making the convention a success.

"BE IT FURTHER RESOLVED: That a copy of this resolution be spread upon the minutes of this meeting and that the secretary be directed to write letters of thanks to those whose efforts have made our convention so enjoyable."

The above resolutions were adopted. Professor Reynolds then suggested that letters be sent to Charles G. Hyde, A. M. Rawn, R. R. Ribal, and to William T. Ingram to tell them that their absence at the Convention was very noticeable, and that we regret that they could not be present.

Mr. A. L. Frick, Jr., reported on the activities of the second annual convention of Federation of Sewage Works Associations in New York City on October 11, 1941. Mr. Frick was alternate representative with Charles G. Hyde on the Board of Control and flew back just in time to attend this meeting. He briefly outlined the organization of the Federation and explained that even with the increase in dues the Manufacturer's Association was contributing a considerable amount to finance the Federation. The tendency towards activities of interest and value to the Operators was demonstrated by the Operators' Breakfast, which was a huge success according to Mr. Frick. He also announced that 1942 National Convention will be held in Cleveland, Ohio.

Mr. Gray opened the discussion on the question of this Associa-

tion's dues being raised from $2.00 to $4.00 per year, as set forth in the proposed amendments to the By-Laws, for membership in the Federation. In response to a suggestion that dues for operators be kept at $2.00, President Gray read a letter from Mr. Rowntree, Operator of the Carmel Plant in which he gave many reasons why every one should be willing to pay the full $4.00. Wayland Jones, Secretary of the San Joaquin Local Section, stated that at their last meeting their members had voted unanimously in favor of the proposed amendments. In answer to Mr. J. F. Smith's question, the President explained that the Federation had amended its By-Laws to permit member associations to determine their own class and status of members and that the California Association had only one class of member. Mr. Woodward stated that in his plant having several operators only one membership would be used by all, and he feared a considerable loss in membership. Professor Reynolds stated that he understood that new issues of the Journal were intended to contain more material of interest and value to the operator.

President Gray then read a letter from Mr. A. M. Rawn, who was attending a meeting in Chicago, in which he expressed himself in favor of joining the Federation.

President Gray then called for a vote on the proposed amendments to the By-Laws. Of the 41 members present, 36 voted in favor of the amendments, with five not voting.

The Constitution and By-Laws of the Federation were then approved.

As there was no further business President Gray turned the meeting over to Mr. Bowlus, the newly elected President. After a brief greeting, President Bowlus adjourned the meeting at 4:15 P.M.

Respectfully submitted,
JACK H. KIMBALL,
Secretary-Treasurer.

REPORT OF COMMITTEE ON FINANCING JOURNAL

The cost of printing and mailingVolume XIII, Nos. 1 & 2, of the California Sewage Works Journal for the year 1941 was as follows:

	Issue No. 1	Issue No. 2
Number of pages	112	124
Cost of printing & mailing	$361.55	$386.91
Income from advertisements	307.80	307.80
Income from sale of reprints	7.50	11.50
Deficit	$ 46.25	$ 67.61

The total deficit for both issues was $113.86 which was 78% of the Association's income for the year 1941. Your committee recommends that this Association adopt the policy of keeping the cost of publishing the Journal within the income received from advertising. This policy may be put into effect by reducing the size and thus the cost of each issue; by raising the advertising rates; or by obtaining more advertisement space.

Respectfully submitted,
J. F. SMITH, Chairman.

REPORT OF SECRETARY-TREASURER

	Debit	Credit	Balance	Deficit
General	$ 527.38	$ 60.27	$ 315.32	$
Secretary		151.79		
Award	50.00	15.00	35.00	
Convention	50.25	17.55	32.70	
Journal	671.82	713.36		41.54
Dues—1940	24.00	18.00	6.00	
1941	568.00	424.75	143.25	
1942	2.00	0.00	2.00	
School for Operators	25.05	28.35		3.30
Certification	29.61	0.00	29.61	
Totals	$1948.11	$1429.07	$563.88	$44.84

Cash on hand 8/19/41 ..... $519.04

CERTIFICATION OF OPERATORS' ACCOUNT

August 19, 1941

Balance 9/7/40	$24.61	
Fees Collected	5.00	
		$29.61
Disbursements		0.00
Balance on hand 8/19/41		$29.61

SCHOOLS FOR OPERATORS' ACCOUNT

Deficit 9/7/40		$ 3.35
Rec'd from G. E. Arnold	$25.05	
Paid to Roy Derby		25.00
Deficit 8/19/41		$ 3.30

Bills Outstanding 8/19/41 ..... $ 0.00

Assets Outstanding 8/19/41
(Accounts Receivable)

1. Currie Engineering Co. Vol. 13, Nos. 1 & 2	$ 10.00	
2. Filtration Equipment Co. Vol. 13, Nos. 1 & 2	50.00	
3. Inertol Company, Vol. 13, No. 2	12.50	
4. Great Western (Dow Chem.) Vol. 13, Nos. 1 & 2	60.00	
		$132.50

Respectfully submitted,
WILLIAM T. INGRAM, Secretary-Treasurer,
CALIFORNIA SEWAGE WORKS ASSN.

REPORT OF SAN JOAQUIN SECTION

In accordance with the provision of the Constitution and By-Laws of the San Joaquin Section of the California Sewage Works Association, I herewith submit a report of the membership activities and finances of the Section.

The section has twelve paid up members and for each meeting fifty cards were sent out. There have been six meetings held so far this year in the following cities: Lodi, Manteca, Folsom Prison, Roseville, Auburn, and Tracy.

I wish to state here that our yearly dues are only 25c and if that amount is

not paid, we still mail the card to those interested in Health Safety and Sewage Disposal.

Treasurer's Report

Balance on Hand September 15, 1940		$ 1.25
Income from 12 members		3.00
Total		4.25
Spent on Cards	$ 2.25	
Spent for Floral Piece	1.75	
	$ 4.00	4.00
Balance on Hand		$ .25

Respectfully submitted,
F. WAYLAND JONES
Secretary-Treasurer.

REPORT OF MEMBERSHIP COMMITTEE

The Membership Committee wishes to report the following:

Total membership on January 1, 1941	281
Members resigned or deceased	5
Members delinquent in dues	37
New Members	51
Total Membership October 14, 1941	290
Subscribers to the C.S.W.A. Journal	5

A third reminder was sent to all members delinquent in dues on September 15, 1941 and in response five members who had misplaced their earlier notices sent in their 1941 dues. It was unfortunate, however, that early issues of the Sewage Works Journal were out of print and these members did not receive all their 1941 copies. Members are urged to pay their dues as early as possible.

Respectfully submitted,
JACK H. KIMBALL,
Chairman.

REPORT OF PUBLICITY COMMITTEE

It is with pleasure that your Committee reports the activities for the year 1941. At our Santa Cruz meeting with the able help of Mr. Rowntree and the local papers, our advance publicity as well as the meetings themselves, were well publicized. For this meeting all the trade journals were notified as well as several radio stations in this vicinity for their broadcast.

Committeeman Harold Jeffery is very ably handling the Sacramento publicity and I sincerely hope that any publicity in the different cities given to your attendance here will be forwarded to me for the Publicity Scrap Book.

Respectfully submitted,
F. WAYLAND JONES,
Chairman.

REPORT OF AWARD COMMITTEE

The Committee on Awards submits the following report concerning the Award of Merit for the Year of 1941.

In May 1941 a letter was sent to all eligible communities announcing the annual Award of Merit and containing a suggested outline for a report and an application blank.

In response two (2) applications and reports were received.

It is the opinion of the Committee that:

1. The Award of Merit for the year 1941 be made to the Folsom State Prison sewage plant.
2. The Second Award be made to Laguna Beach sewage plant.

Respectfully submitted,
ALBERT J. CASTRO,
Chairman.

REPORT OF LEGISLATIVE COMMITTEE

October 14, 1941.

We present herewith the final report of the Legislative Committee concerning bills previously reported to you during the 54th session of the State Legislature in 1940 and 1941. The last previous report was made on June 26th following the close of the Legislature but before the legal time for signature by the Governor had elapsed. We would again refer to our report of April 18, which more completely outlines the bills now reported.

The following previously considered bills and their final disposition is reported below, with the bills which have become enacted statutes reported first.

NEW STATUTES:—

A. B. 1058 (Chap. 323)—"Declares such activities in emergencies caused by military attack or sabotage, great public disaster or calamity, will be conclusively presumed for protection and benefit of inhabitants or property of agency. Provides that all privileges, etc. of officers and employees, including workmen's compensation, apply to extraterritorial activities."

RECOMMENDATION OF C.S.W.A.—"Do Pass" March 27, 1941.

A. B. 1442 (Chap. 322)—New act, Joint Municipal Sewage Disposal District Act. "Provides procedure for establishment and government of Joint municipal sewage disposal districts."

RECOMMENDATION OF C.S.W.A.—"Do Pass" March 28, 1941.

A. B. 1591 (Chap. 1068)—Adds Sec. 24, Act 2119, District Investigation Act of 1933, re sanitary and sanitation districts. Relieves debt limitations.

RECOMMENDATION OF C.S.W.A.—"Do Pass" March 28, 1941.

A. B. 1593 (Chap. 1069)—Adds Sec. 2808 to Streets and Highway Code, re construction or acquisition of sanitary sewer and sewage disposal works. Relieves debt limitations.

RECOMMENDATION OF C.S.W.A.—"Do Pass" March 28, 1941.

A. B. 2006 (Chap. 1215)—An act for protection of domestic water supplies from pollution by placer mining operations.

NO RECOMMENDATION BY C.S.W.A.

REPORTED BILLS WHICH FAILED AT PASSAGE:—

A. B. 2198—To amend Sec. 481, Fish and Game Code. Refers to pollution of State waters, establishes standards to determine when pollution occurs.

NO RECOMMENDATION BY C.S.W.A.

A. B. 2258—Requires sewage disposal plant and garbage incineration by every public body.

RECOMMENDATION OF C.S.W.A.—"Lay on table" 3/28/41.

S. B. 100—Concerns deposit of substances in State waters. Provides deposit unlawful when detrimental to public health.

NO RECOMMENDATION BY C.S.W.A.

A. B. 1302—State Plumbing Act. Applicable to unincorporated areas.
NO RECOMMENDATION BY C.S.W.A.

A. B. 1589; A. B. 1590; A. B. 1592—Proposed amendments to certain sections of "Special Assessment Investigation, Limitation and Majority Protest Act of 1931" (A.B. 1589 and A.B. 1590) and to "District Investigation Act of 1933 (A. B. 1592).
RECOMMENDATION OF C.S.W.A.—"Do Pass" 3/28/41.

In addition to the above bills which have been considered by the Legislative Committee and reported to the officers and members of the California Sewage Works Association, there are certain other bills affecting sanitation and sewage disposal which were passed during the last legislative session and are now in the Statutes. We list these new statutes below together with a very brief description of their nature.

ADDITIONAL NEW STATUTES:—

A. B. 1440 (Chap. 321)—Permits county sanitation and sanitary districts, as well as cities and county water districts, to form or be annexed to municipal utility districts. Allows such districts to sell water, effluent, fertilizer and by-products of sewage disposal systems, to construct such systems, to accept Federal aid and to contract with State or public agencies. Provides procedure for setting up, government and dissolution of special districts within municipal utility districts for sewage disposal purposes.

A. B. 2647 (Chap. 931)—Adds Sec. 30.1, Act 6391, Public Utility District Act, re sewage works. Authorizes Public Utility District to contract with political subdivisions, public corporations, or others, for joint acquisition, construction or use of sewage disposal facilities, for period not to exceed 25 years. In effect immediately.

S. B. 642 (Chap. 965)—Sanitation and Sewer Revenue Bond Act of 1941. Provides in detail for issuance, terms, and payment of revenue bonds for acquisition, construction, or operations of sanitation or sewer systems by cities, counties, municipal and public corporations, and public districts.

Exempts bonds, including interest and income, from taxation, except gift and inheritance taxes. Provides for certification of bonds by California Districts Securities Commission.

A. B. 1591 (Chap. 1068)—Adds Sec. 24, Act 2119, District Investigation Act of 1933, re sanitary and sanitation districts. Makes all except majority protest provisions inapplicable to formation of sanitary or sanitation districts when formation recommended by health officer, and found by 4/5 vote of legislative body necessary and feasible, that property will be able to carry burden and that probable assessment will not exceed limitations set up in act.

A. B. 1595 (Chap. 1071)—Amends sections of Act 2119, District Investigation act of 1933, re investigation report and debt limitations. Exempts proceedings for formation of sanitary or sanitation districts from provisions of act under certain conditions.

A. B. 1596 (Chap. 1072)—Amends and adds sections to Health and Safety Code, re sanitation and sanitary districts. Declares that street improvement statutes do not authorize improvements which sanitation and sanitary districts are not otherwise empowered to make. Requires recording of certified copy of sanitation or sanitary districts assessment and diagram to make assessment lien.

Permits issuance of bonds for lateral extension of sewers by sanitary districts formed under 1923 act under any improvement act made applicable to such district.

S. B. 1076 (Chap. 741)—Amends Secs. 777 and 874, Act 5233, re fifth and sixth class cities. Makes procedure prescribed for letting contracts for public works in applicable to maintenance of streets or sewers, or to projects for which expenditures are $1000 or less. Changes procedure for letting such contracts in fifth class cities.

S. B. 1206 (Chap. 990)—Adds to and removes sections from Health and Safety Code, re sanitary districts. Provides procedure for districts formed under acts of 1891 or 1919 to use assessment roll of county in which district is located as basis for district taxation.

A. B. 285 (Chap. 82)—Grants leaves of absence of public employees for military service to all but elective officers of public bodies.

A. B. 595 (Chap. 5)—Adds section to Health and Safety Code, re Sanitary Districts. Permits annexation of territory separated from district.

A. B. 1927 (Chap. 225)—Amends Health and Safety Code, re Sanitary Districts. Permits annexation of territory in same county if it touches district at any point.

Signed:—LEGISLATIVE COMMITTEE, A. P. BANTA, E. B. BELT, H. W. JEWELL, C. C. KENNEDY, C. M. HOSKINSON, Chairman.

REPORT OF JOINT COMMITTEE ON SCHOOLS FOR AND CERTIFICATION OF WATER AND SEWAGE WORKS OPERATORS

In the past schools have been held alternately in Northern and Southern California. In 1940, it was felt that, due to difficulty in holding schools in Northern California, regional conferences of operators would be better adapted to the operators' needs and accordingly several were successfully held that year in the Northern part of the state under the able guidance of G. E. Arnold and his committee.

The year 1941 brought the school to Southern California again and because of the splendid cooperation given by the University of Southern California in past years it was decided to hold a school here as before. Because of their success in the North, the idea of regional conferences was also looked on with favor and plans were also made to hold them in addition to the school. This decision was also aided by the result of a straw vote taken following the school of 1939 at U.S.C. in which the operators were asked which of various subjects they wished more emphasis placed, e.g., Laboratory, Field Trips, Theory, Fundamentals, and Discussion of Operating Problems. Over 80% wished to discuss operating problems and 67% wished more laboratory work. The other factors rated 50% or less.

Because of desire for laboratory work, Lt. Col. Jack Hinman of U. S. Engineers Board, and lately of Iowa was invited out by the University to act as leader. A course of lectures and laboratory work on bacteriology, microscopy and chemistry as related to water and sewage work covering five days was arranged and held June 9 to 13. The attendance averaged 26 with a total of 58 registered and drew from eleven cities and four states. While the average attendance was somewhat below that of previous years, due in some measure to defense conditions, interest was high and Col. Hinman commented very favorably on the reaction of the class in the laboratory, saying it was the best he had ever instructed outside of University classes.

Five regional meetings were held in Southern California, one being in Yuma, Arizona, March 21 to 23. This was a joint meeting with Arizona Water and Sewage Works Association, which had a total attendance of 45 Californians of which 35 were members of the C.S.W.A., A.W.W.A. or both. The other four meetings were held at follows:

Los Angeles, January 29 Attendance 54.
Anaheim, February 11 Attendance 25.
Anaheim, April 18 Attendance 30.
Los Angeles, September 24 Attendance 26.

Mr. Blair I. Burnson was given the task of continuing the regional meetings in Northern California.

All present at meetings were highly interested and discussions very generally entered into. These meetings should be continued each year by all means.

During the year eight applications for certification change of grades were received. Two applicants were examined at the Spring Conference and two certificates issued. The others are being acted on by the Committee and will be examined at the Fall meeting if the applicants are present.

One item that has come to the attention of the Committee has been lack of written examinations for applicants. In the opinion of the Committee all applicants for Grades II and I Certificates should pass a written examination as well as oral, and records of these examinations kept. In the case of Grade III Certificates, where the men are often in subordinate positions and find it difficult to attend meetings of the Association and so are unable to take an examination, the Committee felt that under such circumstances the issuance of a Certificate (Grade III) on record and qualifications only might be permissible, and interest thereby stimulated. However, for any other grade, particularly Grade I, all requirements, educational, experience and examinations should be strictly adhered to.

FINANCIAL STATEMENT

Revenue:

From Secretary A.W.W.A.	$25.00	
From Secretary C.S.W.A.	25.00	
J. C. Clark, Applicant	1.00	(Sewage Operator)
J. E. Hodges, Applicant	1.00	(Water Operator)
Sale of notes at school	12.50	(25 books at $.50)
Total revenue	$64.50	

Expenditures:

Mimeographing Col Hinman's notes	$19.72
Expenditures, Anaheim Meeting	2.50
Total expenditures	$22.22

Cash on hand: $42.28

Due A.W.W.A.	$21.14
Due C.S.W.A.	21.14
	$42.28

Respectfully submitted,
Joint Committee on Certification of and Schools for Water and Sewage Operators
Calif. Sewage Works Association, Calif. Sec. Amer. Water Works Assn.
R. L. DERBY,
Chairman.

REPORT OF COMMITTEE ON SAFETY STANDARDS

The report of the committee at the Spring meeting has divided the subject into two distinct parts, 1: "Safety Standards to be Considered in the Design," and, 2: "Safety Rules and Regulations Pertaining to Operation." We believe that each should be further divided into subheadings, and submit this for further consideration.

1: SAFETY STANDARDS TO BE CONSIDERED IN THE DESIGN:

a: Gas Collection and Utilization or Disposal:

This should cover gas collectors which will be so designed that high gas pressures cannot be built up due to clogging of the gas line. The gas piping

should be of proper size and provided with flames arresters and drip traps. Care should be taken that lines will drain to the traps. Uniform pressure should be maintained either by gasometers or backpressure regulators.

Sufficient gas storage should be provided which would prohibit the formation of partial vacuums and the accompanying admission of air into the digestion compartments during sludge withdrawal.

b: Electrical Equipment:

This subject was well covered in a paper by Mr. Frank A. Short, Engineer for the State Industrial Accident Commission, printed Page 37, Volume 12, No. 2 of the C.S.W.A. Journal.

The interpretation of the rules of the Commission should be modified so as to more carefully determine the classification of the hazardous locations. Definitely, all buildings or rooms of a sewage treatment plant are not hazardous from a gas explosion standpoint. Many plants have been required to install explosion proof switches and motors where the location is no more hazardous than the average home which has gas piping and gas appliances. There are several plants where explosion proof electrical equipment has been required with the switchboard located in a separate outside room, and yet a gas boiler and Bunsen burners are allowed in the socalled hazardous location.

c: Stairs, Ladders, Railings and Curbs:

This item should cover the use of railed stairways instead of manhole steps or ladders and the construction of curbs and railings around all floor openings. However, the present rulings of the Accident Commission are such that at the Visalia, California plant as well as others, a stair or a ladder from the ground to the top of the trickling filter bed would have required the construction of a railing around the entire bed.

d: Belt, Chain or Gear Driven Equipment:

The regulations requiring housing of all belt, chain or gear driven equipment should be carried out to the letter, even though considerable extra inconvenience in operation be caused.

e: Floors and Gratings:

While there is a strong temptation to smooth trowel all concrete floors in order that they may be cleaned more easily, from a safety standpoint a float finish is much safer.

Where steel grating is used, care should be taken that the grating lies flat and has sufficient bearing.

f: Proper Lighting and Ventilations:

The requirements for proper light and ventilation are pretty much self evident. All pits subject to chlorine or sewer gas should be provided with forced ventilation. All walls and ceilings above a five-foot wainscot should be painted white, and wherever possible, dry wells and other pits should be so designed as to provide daylight as well as plenty of artificial light.

2: RULES AND REGULATIONS PERTAINING TO OPERATION:

a: Personal Cleanliness of Operator to Avoid Infection:

Unless absolutely impossible, all plants should be provided with drinking water, a sink, plenty of soap and paper towels. The operator should be required to wash his hands thoroughly after any contact with the sewage, for at least one operator has contracted a severe case of amoeba dysentery from sewage contamination. An operator who chews tobacco or smokes a pipe on the job is really asking for trouble.

b: Cleanliness of Plant:

Oil spilled on the floor is dangerous, and dirty windows and light globes tend to poor lighting.

c: Performance of Duties Requiring Two or More Men by One Operator:

No matter how small the plant, there are always some duties which should

not be performed by the operator without additional help. They include moving and connection of large chlorine containers and the lifting and moving of any heavy equipment, the cleaning of wet walls, manholes, digestion tanks and other places where sewage or chlorine gas is liable to concentrate.

It is evident that considerable more thought and work should have been put into this report. No definite findings or conclusions could be attempted with the information available at this time. Our only hope is that this report may show the advisability of the continuance of a committee on safety standards, as the present rigid interpretation of the rules of the State Accident Commission add considerable expense to the construction cost of our sewage treatment plants, and yet most of the present day plants leave much to be desired from a safety standpoint.

We hope a committee on safety standards will be provided for the ensuing year, and that the State Accident Commission will be asked to cooperate with the committee.

Respectfully submitted,
COMMITTEE ON SAFETY STANDARDS,
By F. S. CURRIE, Chairman.

REPORT OF COMMITTEE ON INDUSTRIAL WASTE

The rapid increase of industrial waste disposal problems throughout the United States is causing engineeers and others interested in the matter to give such problems considerable attention. Disposal of liquid wastes into sewers is tending to overtax the sewer capacity, and records of the volume of waste are needed.

The quality of the indusrial waste is also a factor that should be known, as the suspended solids and grease in the waste are causing trouble to both collecting systems and treatment works. Believing that the California Sewage Works Association can assist considerably in obtaining a control of these problems, the writer in the latter part of 1940 suggested to the President of the Association that he appoint a committee to act as an advisory body in the matter.

After due consideration, the President appointed such a committee, consisting of eight members of the Association with the writer as Chairman. To represent the various sections of the State and varied interests, half of the Committee were located in the North and half in the South. The personnel of the Committee is given in the California Sewage Works Journal, No. 2 of 1941.

Each of these two divisions of the Committee held meetings to decide as to the general policy to be carried out. It was recognized that the problems created by the disposal of industrial wastes would sooner or later require investigation, and that data concerning treatment must be prepared. However, at the start, it was felt that information should be obtained as to the volume and character of the wastes.

In order that each member of the Committee should express himself as to the order of preference in the arrangement of items to be listed, the two divisions of the Committee studied the outline of such items as were submitted by its different members, and agreed upon the plan that the industries in the State should be listed geographically by counties and cities, and then according to the type of the various industries concerned. The amount of volume of the wastes was then desired, together with the B.O.D., suspended solid, and grease content in the wastes. The method of describing the characteristics by the number of parts per million was also agreed upon.

Following a general meeting of the Committee at Santa Cruz in April, 1941, and separate meetings of the two divisions of the Committee in the North and South, a general meeting was held at San Diego, in July, 1941. It was

then decided that the Committee should proceed as rapidly as possible to acquire records of data concerning the industrial wastes throughout the various cities of the State and elsewhere when available. Such data had already been sent to the Committee from a survey made by the City of Los Angeles, and some records have been obtained from the sewage disposal survey of the East Bay cities. The Bureau of Sanitary Engineering in the State Department of Public Health may be able to add some data.

The Committee has sent a Record Form to over 75 City Engineers of the cities of California with the request that each City Engineer contact the industries in his locality and fill out the places on the form where such data can be obtained. The form sent also asks for the number of employees in each industry, the type of plant and waste, water consumption, volume of waste, and the time of operation, if seasonal. Physical and chemical data are also requested. A copy of the Record Form and letter to the City Engineers accompanies this report.

For convenience, the industries are asked to report the magnitude of operations in their own familiar units, such as **Washers** for bottling works, **Barrels** for breweries, **Tons packed** for canneries, **Drums** for cooperage, **1000 lbs. of milk per day** for creameries, **Tubs** for laundries and dyeing plants, **Tanks** for film plants, and the kill as **Bullocks** for meat packing and slaughter houses. For each different type of plant, the number of units is requested.

Since sending out the questionaire to the City Engineers, the Chairman of the Committee has received a few replies from some City Engineers, who state "that there are few, if any, industries in their cities, and that there is but little, if any, waste entering the sewers." No record is kept, however, and this condition should be corrected before such replies are made. There must be co-operation between the City Engineers and the industries in their cities, but some action by the Engineers should be taken. Possibly when the volume of the waste increases, the Engineers will see the need of attention.

Publicity of this subject of industrial waste disposal and the need of data thereon has been given in the Western City and South West Builder and Contractor, and will also be sent to other publications. Data received from the City of Los Angeles is given in the following pages. City Engineers having any data that may be available for the Committee are requested to co-operate in this matter.

Since writing the above, your Committee has held one more meeting in Los Angeles to consider the foregoing report and add or subtract therefrom what is desired. It, however, concurs with what has been written, but wishes to add the following:

Due to the need of additional personnel, the Committee recommends, 1st: that the present membership of the Committee be retained on the Committee; 2nd, that D. R. Kennedy of Long Beach, E. P. Hapgood of Anaheim, B .D. Phelps of San Diego, and a representative from the Fresno district be added to the Committee; 3rd, that the Committee be instructed to arrange for personal contacts through its members and representatives of the industries in those cities for the purpose of obtaining the data requested on September 15 of the city engineers.

The scant data sent in the first twelve replies received makes this action necessary to obtain the data required by the Committee. As a result of such action, the Committee should then be in a position to recommend constructive plans towards some control of the disposal of industrial wastes.

In closing, the Chairman wishes to thank the various members of the Commitee for their co-operation, and to submit his resignation as Chairman, for the reason that, having now retired from active service with the City of Los Angeles, this position should be filled by one who is in active service.

W. T. KNOWLTON, Chairman.

California Sewage Works Association
Committee on Industrial Wastes—1941

RECORD FORM FOR DATA CONCERNING TYPE, VOLUME, AND CHARACTERISTICS OF INDUSTRIAL LIQUID WASTES

Use Separate Form for Each Industry Reported

1. SAMPLE COLLECTED
   Year..... Month..... Day..... Hour..... Remarks.....
   .....
   .....

2. LOCATION OF SOURCE:
   State..... County..... City..... Street..... No.....

3. TYPE OF INDUSTRY: (Mark X for type reported on this form)

(a) Bottling.....	(d) Cooperage.....	(g) Meat Packing.....
(b) Brewery.....	(e) Creamery.....	(h) Oil.....
(c) Cannery.....	(f) Laundry.....	(i) Paper.....
Fish.....	Domestic.....	(j) Film Plants.....
Fruit.....	Overall.....	(k) Cleaners and
Veg.....	Waste Rag.....	Dyers.....

4. VOLUME OF WASTE DISCHARGE TO SEWER:
   Gallons per day.....
   Gallons per week.....
   Gallons per month.....
   Water Consumption.....

5. PLANT OPERATION:
   (a) Days per week.....
   (b) Days per mo.....
   (c) mos. per yr.....
   (d) hrs. per week.....
   (e) aver. no. empl:.....

6. TYPE AND NUMBER OF UNITS:

Industry	Type of Units	No. of Units	Industry	Type of Units	No. of Units
Bottling	Washers	.....	Laundries and Dyers	Tubs	.....
Breweries	Bbls	.....		Bullocks per day	.....
Canning	Tons packed	.....	Meat Packing	per week	.....
Cooperage	Drums	.....		per month	.....
Creameries	1000 lbs. of milk per day	.....	Film Plants	Tanks	.....

Note: 1 Bullock—1 cattle—3 hogs—5 calves— 7 sheep.

7. CHARACTERISTICS:

(a) Susp. Solids.....ppm	(e) Settleable Solids cc/liter/30 min. .....
(b) Grease.....ppm	(f) Temperature.....°F
(c) B.O.D.....ppm	(g) Chlorides.....ppm
(d) pH.....	

8. TEST FREQUENCIES .....

9. SOURCE OF INFORMATION .....

10. PLANT AGE AND FORECAST .....

SEWER FACILITIES RECORD
CHARACTERISTICS OF INDUSTRIAL WASTES ENTERING LOS ANGELES SYSTEM

Industry Type of Plants	Volume Total Amount	Gals. per day Units Type	No.	Amount	Susp. Solids p.p.m.	Grease p.p.m.	Population Equivalent Persons/Unit	pH Max.	Settleable Solids 1 Hr. %	Temperature °F
Bottling	125,000	Washers	6	20,800	.....	.....		.....	.....	.....
	41,000	"	2	20,500	.....	.....		.....	.....	.....
	35,000	"	2	17,500	.....	.....		.....	.....	.....
			Av.	19,600	107	23		9.0	0.15	79
Bottle Washers	44,000	Washers	1[A]	22,000[B]	.....	.....		.....	.....	.....
	31,000	"	2	15,500	.....	.....		.....	.....	.....
			Av.	19,000	265	39		9.0	2.5	80-110
Breweries	305,000	Bbls.	1200	254	.....	.....		.....	.....	.....
	92,000	"	340	270	.....	.....		.....	.....	.....
	56,000	"	135	415	.....	.....		.....	.....	.....
			Av.	313	1500	130		6.5	0.2-6.0	75-140
Canning		Tons								
(a) Spinach		packed	.....	6,500	275	26		7.5	.....	70
(b) Tomato		packed	.....	6,500	920	175		5.0	.....	100-110
Cooperage		Drums	.....	35	2100	4300		.....	0.5-1.0	120-140
Creameries	240,000	1,000 lbs.	158	1,510	600	300		8.0	.....	95
	209,000	milk/	167	1,240	390	160		9.0	.....	90
	139,000	day	95	1,460	840	1200		8.0	.....	85
			Av.	1,400	610	550		8.3	Tr. 0.2	90
Laundries—										
(a) Domestic	344,000	Tubs	55	6,250	190	370		9.0	.....	130
	200,000	"	39	5,130	110	360		9.0	0.5-1.0	140
	153,000	"	20	7,650	280	270		.....	.....	.....
	45,000	"	11	4,100	320	990		9.0	0.5-1.0	140
			Av.	5,780	240	500		9.0	Tr.-1.0	.....
(b) Overall	80,000	Tubs	10	8,000	850	250		.....	.....	.....
	27,800	"	3	9,270	550	310		.....	.....	.....
	3,850	"	3	1,300	.....	.....		.....	.....	.....
			Av.	6,190	700	280		9.0	0.3-1.5	75-150

Notes: [A] Indicates 16 hrs/day.
[B] Indicates 8 hrs/day.

SEWER FACILITIES RECORD
CHARACTERISTICS OF INDUSTRIAL WASTES ENTERING LOS ANGELES SYSTEM

Industry Type of Plants	Volume Total Amount	Gals. per day Units Type	No.	Amount	Susp. Solids p.p.m.	Grease p.p.m.	Population Equivalent Persons/Unit	pH Max.	Settleable Solids 1 Hr. %	Temperature °F
(c)Waste Rag	98,000	Tubs	6	16,300	3320	3620		9.0	.....	.....
	25,000	"	6	4,200	6880	3300		.....	.....	.....
	19,000	"	3	6,300	.....	.....		.....	.....	.....
	16,000	"	3	5,300	780	610		.....	.....	.....
			Av.	8,000	3660	2540		9.0	1.0-1.5	100-150
Meat Packing	1,013,000	Bullocks	870	1,165	2950	1050		.....	.....	.....
	401,000	"	419	958	1700	950		.....	.....	.....
	380,000	"	290	1,310	.....	.....		.....	.....	.....
	207,000	"	270	763	1290	370		.....	.....	.....
			Av.	1,050	1980	790	30 7.6		0.3-1.0	90
Paper					485	60		7.0	3.-12	75
Soap . . .	202,000				1250	740		9.0	0.5	80-140
Yarn and Rayon	59,000	Tubs	10	5,900	.....	.....		.....	.....	.....
	34,000	"	6	5,670	.....	.....		.....	.....	.....
Dyeing Plants	27,000	Tubs	5	5,400	.....	.....				
	14,000	"	4	3,500	.....	.....				
			Av.	5,120	95	95		9.0	Trace	90-175
Film[D]										
	340,000	Tanks	.....	.....						
	122,000	"	8	15,250	.....	.....				
	25,000	"	2	12,500	.....	.....				
			Av.	13,875	43	13		7.5	0	62
Dyers and Cleaners					118	166		8.0	.....	80-140
Dry Ice Mfg.					0	61		6.0	.....	110

Notes: [D] Indicates 13 to 25 gals. per foot of film.
[C] Indicate 1 cattle, 3 hogs, 5 calves, and 7 sheep.

(*Insert Page* 21-B)

REPORT OF COMMITTEE ON REVISION OF CONSTITUTION AND BY-LAWS

The Constitution and ByLaws of this Association were last printed in their entirety in our Journal, Vol. XII, 1940, No. 1, pages 73-76. Two amendments to the By-Laws were subsequently printed in Vol XIII, 1941, No. 1, page 100.

On April 22, 1941 the Committee on Revision of Constitution presented a preliminary report at the Santa Cruz Conference, and a policy and certain amendments were tentatively accepted. Subsequent changes in the By-Laws of the Federation of Sewage Works Associations made it impossible to follow the policy adopted at Santa Cruz.

In the absence of the chairman of our Revision Committee, President Gray sent out a statement to all members outlining the general situation with reference to the relation of our Association to the Federation. Possible amendments were presented without recommendation as a basis for discussion at our annual meeting at Sacramento, October 14, 1941. At this meeting these amendments were presented, discussed and adopted.

Our Constitution and By-Laws as amended are printed in their entirety in this Journal.

Respectfully submitted,
LEON B. REYNOLDS, Chairman,
B. D. PHELPS,
C. G. GILLESPIE.

CONSTITUTION AND BY-LAWS OF THE CALIFORNIA SEWAGE WORKS ASSOCIATION AS AMENDED OCTOBER, 1941

CONSTITUTION

ARTICLE I

Name

The name of this association shall be CALIFORNIA SEWAGE WORKS ASSOCIATION.

ARTICLE II

Object

The object of this Association shall be the advancement of the fundamental and practical knowledge concerning the nature, collection, treatment and disposal of sewage and industrial wastes, and the design, construction, operation and management of sewage works in California, through the interchange, between members of the association and with others, of information, experience and opinion relating thereto.

ARTICLE III

Membership

Membership shall be of one kind only—to be known as members. Any person, or any Board, Commission or Department interested in the objective of this Association, or any person engaged in the sale or manufacture of sewage works equipment, may be a member of the Association. Each membership shall be entitled to one vote.

ARTICLE IV

Officers

The officers of the Association shall be, a President, two Vice-Presidents,

designated as First and Second Vice-President, a Secretary-Treasurer, and five Directors. These nine officers shall constitute the Governing Board of the Association.

ARTICLE V

Amendments

Amendments to the Constitution may be made by a two-thirds vote of the members at the annual meetings, after notice of the proposed amendments shall have been mailed to each member in advance.

BY-LAWS

ARTICLE I

Members

Section 1. All members of the preliminary organization shall be members of the Association, without election.

Section 2. Application for membership in the Association shall be made in writing to the Secretary-Treasurer and the applicant must be accepted by a majority vote of the Governing Board as a prerequisite to membership.

Section 3. Any member may be expelled from the Association for cause by two-thirds vote of the Governing Board.

Section 4. Any member may retire from membership by giving written notice to that effect to the Secretary-Treasurer.

Section 5. Any member whose dues are in arrears shall be dropped from membership by the Secretary-Treasurer, provided that any member who has been dropped from membership for non-payment of dues may be reinstated at any time within one year by the Secretary-Treasurer upon payment of current dues.

ARTICLE II

Dues

Section 1

Annual dues shall be as follows:

(a) for those members who desire to receive all publications of the Federation of Sewage Works Associations, the sum of four dollars.

(b) for those members who desire to receive only alternate issues of "Sewage Works Journal," the sum of two dollars and fifty cents.

(c) members paying dues under paragraph (b) of this section shall be limited to those members who for acceptable reasons are so classified by the Governing Board of the Association. In no case may the number of members paying dues under paragraph (b) be more than fifty per cent of the total membership of the Association. To be classified under paragraph (b) a member must make written application therefor to the Governing Board of the Association, which must approve such application before classification under paragraph (b) is allowed.

(d) Annual dues shall be payable in advance on October first, for the subsequent calendar year, and shall be in arrears on February first of such calendar year.

(e) The annual dues of members residing outside of North America shall be five dollars, and such members shall be entitled to receive all publications of the Federation of Sewage Works Associations.

Section 2. The fiscal year covers the period between January 1st and December 31st.

Section 3. Of the annual dues paid to the Secretary-Treasurer, there shall be paid to the Federation of Sewage Works Associations such amounts per member as shall be prescribed by the by-laws of the Federation of Sewage Works Associations for members as classified under paragraphs (a), (b) and (e) of Section I of this Article.

Section 4. Any member whose dues are delinquent shall not receive publications of the Association or Federation until such dues are paid. Any member who shall have been reinstated to membership, as provided in Article 1, Section 5, of these By-Laws, shall then be entitled to receive such numbers of the Association or Federation publications as may have been withheld on account of non-payment of dues, provided such publications are still available.

ARTICLE III

Section 1. Officers of the Association shall be elected from persons holding individual memberships in the Association.

Section 2. The President, First and Second Vice-Presidents and the Secretary-Treasurer shall be elected to serve from the close of one annual meeting until the close of the next annual meeting.

Section 3. Directors shall be elected to serve for a term of five years each, except as follows: At the first annual meeting in 1928 there shall be five Directors elected: One to serve one year, one for two years, one for three years, one for four years and one for five years, and at each annual meeting subsequent to the annual meeting of 1928 there shall be one Director elected to serve for five years. A year shall be taken to mean the time elapsed from the close of one annual meeting until the close of the next annual meeting.

Section 4. No elective officer, excepting the Secretary-Treasurer, shall be permitted to succeed himself in office but any officer shall be eligible for any other office.

Section 5. The First Vice-President shall succeed the President in case of vacancy in the office, and other vacancies shall be filled by appointment by the Governing Board, appointees to hold office until the next annual meeting of the Association, at which time any unexpired term of office shall be filled at regular election.

Section 6. The President shall have general supervision of the affairs of the Association, subject to the direction of the Governing Board. He shall preside at all meetings of the Association.

Section 7. The Governing Board shall have full control of the affairs of the Association, subject to the acts of the Association in regular meetings. The President shall be chairman of the Governing Board and preside at all meetings. The Board shall meet at the call of the President and shall hold a meeting just prior to the opening of the annual meeting of the Association. All questions before the Governing Board, except that of expulsion, shall be decided by a majority vote. Five members shall constitute a quorum. The Governing Board shall also vote by letter ballot at the request of the President, which vote shall be conclusive provided a quorum votes.

Section 8. Not less than 30 days after the annual meeting the President shall submit to the Governing Board the names of all committeemen for the ensuing year and the Governing Board shall decide upon their selection prior to appointment.

Section 9. It shall be the duty of the Secretary Treasurer to attend, and to record the proceedings of, all meetings of the Association and of the Governing Board. He shall also attend to the collection of all dues and money due the Association and shall prepare all claims against the Association for payment and shall pay the latter upon approval thereof by the President.

Section 10. The officers of the Association shall not incur any liability on behalf of the Association except with the approval of the President and not in excess of the amount actually in the treasury. At the annual meeting the Secretary-Treasurer shall make a report of the financial condition of the Association.

Section 11. The Governing Board shall appoint a representative to serve on the Board of Control of the Federation of Sewage Works Associations, who shall serve for a term of three years. A vacancy shall be filled by the Governing Board. This representative shall, whenever possible, attend meetings of the Governing Board and participate in its discussions, but without the right to vote.

ARTICLE IV

Meetings

Section 1. There shall be an annual meeting of the Association, the time, place and duration to be determined by the Governing Board.

Section 2. Spring Conferences and special meetings may be held at such times and places as may be determined by the Governing Board.

Section 3. Ample notice of all meetings shall be given each member by mail.

Section 4. A registration fee of twenty-five cents, when declared necessary by the Governing Board, shall be collected at the Fall Convention and Spring Conference.

ARTICLE V

Local Sections

Section 1. An area group may form a Section of this Association, subject to the approval of the Governing Board, and its name shall indicate such affiliation. Application for the formation of a Section, with its proposed name and area, accompanied by a copy of its proposed Constitution and By-Laws, shall be filed with the Secretary-Treasurer of the Association at least sixty days before the annual meeting and copies thereof shall be transmitted by him to members of the Governing Board. Action of the Governing Board upon the application shall be taken at the next annual meeting.

Section 2. Membership in a Local Section shall be limited to members of the Association who are located within the Section area. No member shall be enrolled in more than one Section.

Section 3. Dues may be fixed by each Section which shall not include membership dues in the Association.

Section 4. Each Section shall have at least one officer known as the Section Secretary-Treasurer. Prior to the annual meeting of the Association he shall submit to the Secretary-Treasurer of the Association a report of the membership, activities and finances of the Section.

Section 5. Each Section shall conduct its meetings and regulate its business in a manner consistent with the objects and policies of the Association.

ARTICLE VI

Publications

The California Sewage Works Association shall publish a Journal. All papers presented at its meetings shall be the property of the Association, subject to publication in its Journal. Papers may be released for publication in the Journal of the Federation without impairment of the right of the Association to publish them in the California Journal.

ARTICLE VII

Amendments

Amendments to the By-Laws may be made by a two-thirds vote of the members at the annual meeting, after notice of the proposed amendments shall have been mailed to each member in advance.

THE EVALUATION OF INDUSTRIAL WASTES IN THE EAST BAY

By **ROY E. RAMSEIER***

In order that the East Bay might some day lose its characteristic odors and smell more like a modern civilized community, a start has been made in the general direction of removing the causes of the stench that greets all persons entering Oakland or Berkeley along the East Shore Highway.

The East Bay Cities Sewage Disposal Survey was organized by seven cities of the East Bay, who realized that a comprehensive plan of sewage disposal is necessary to abate the odors and unsightly sewage deposits, only a portion of which are on the western water front.

As Assistant Engineer, one of my duties was the determination of the strength and quantities of sewage contributed by all sources in the area.

The East Bay region includes an area roughly twenty miles in length and about four and one half miles in average width. Sewage from this area now discharges into the surrounding tidal water at sixty different points. As a great many of these sewers are periodically flooded with tide water, it was consequently decided that the direct measurement and sampling of the sewage discharge would be impractical, if not impossible. The method actually used for sampling the sewage of the East Bay was that of integration, or synthesis. The survey sampled and measured the sewage of the area in a manner similar to that used throughout the nation to sample and evaluate public opinion.

Two major groups of sewage contributors are at once evident. Wastes from residential and business districts ordinarily provide the greatest amount of sewage. Industrial wastes in the East Bay, however, are of great enough quantity to average from one third to one half of the total sewage load. In some of the drainage areas, the proportion of industrial waste is considerably greater than in others.

The general methods of sampling and evaluating all wastes, whether domestic or industrial, were similar. The factors needed for a proper evaluation in all cases are:

1. The magnitude of the contributor, expressed in the number of units of contributing groups; for domestic groups, the number of people; for industrial wastes, the amount of product or other index of activity.

2. The average amount of sewage constituents contributed by each unit.

The first factor is obtained by a census of the area studied. On the East Bay Survey all of the studies were compiled for drainage areas, or sewage sheds. Long and tedious compilation of the 1940 census enumerations gave the number of people contributing to each

*Sanitary Engineer, City of Richmond, Calif.

sewer. Visits to all of the major industries provided the industrial census of each drainage area.

The amount of sewage, its contents in pounds of bio-chemical oxygen demand, suspended solids, and grease, contributed by each person is remarkably consistent. In eleven widely scattered sewers in the East Bay, measuring flumes were installed; and for each of these sewers week-long sampling schedules were maintained. Samples were collected and composited in proportion to the amount of flow in the sewer. Laboratory analyses were made of these samples and the results obtained were reduced to obtain the following values:

Amount of sewage per capita—43.9 gallons per day.
Amount of B.O.D. per capita—0.104 pounds per day.
Amount of suspended solids per capita—0.107 pounds per day.
Amount of grease per capita—0.109 pounds per day.

Waste discharged to the sewers by industries varies considerably in both volume and composition. The following information was obtained from every industry evaluated:

1. The amount of raw product used, the amount of the plant output, or sometimes, only the amount of water used by the plant. The unit used to describe the activity of the industry must be decided after a preliminary examination of the processes producing the waste. For a seasonal industry the variation of production throughout the year must also be known.

2. The amount of waste produced by a given number of units of activity, and representative samples of that waste.

The first step in determining the industrial wastes of the community is to list the industries contributing, or liable to be contributing. On the East Bay Survey, the Buyers Guide, published by the Oakland Chamber of Commerce was quite helpful. This list had the disadvantage of being too complete. Industries having their place of business in a single car residential garage are listed the same as those covering several acres. Valuable from the standpoint of location, the Industrial maps of the Southern Pacific Company lists the larger industries. Then there is the telephone directory's classified section, but this too, includes all agencies as well as the industrial plants themselves. One of the most valuable lists of industries is that of the Water District's larger users. From this list it was possible to pick out many of the larger users of water, who are also some of the larger producers of industrial wastes. A supplementary list of many of the larger well water users helped to complete the record of water usage.

All of the industries found by studying the various lists were grouped by sewage sheds for aid in the final compilation of information.

The survey started officially on July 1, 1940. Although this was back in the days before priorities, considerable difficulty was experienced in obtaining the laboratory equipment. When this equipment was forthcoming we had to work fast to be certain that we did not miss any of the seasonal industries. The canneries were in full opera-

tion on peaches and pears by the time we got started. Other crops followed rapidly and we shifted from one cannery to another in order to get information on as many crops as possible.

Cannery wastes are a distinct and important part of the sewage of the East Bay Communities. Wastes from this one industry during the peak of the season increase the sewage loading in terms of biochemical oxygen demand and suspended solids by about fifty percent over the loading from all domestic and non-seasonal industrial sources together.

From the point of view of industrial wastes, the peak of the canning season is during the overlap of the peach-pear and tomato seasons. Tendencies for this overlap to increase due to the holding of peaches and pears in refrigerated warehouses has been noted. Whether the volume held for late canning will be enough to cause concern is for the future to determine. That the product causing the high peak is the peach-pear combination is readily apparent from an investigation of the various wastes. During the 1940 season, 52,000 tons of peaches and 40,000 tons of pears were canned, producing a total seasonal load of between 3,830,000 and 5,261,000 pounds of B.O.D., depending on the percentage of solid wastes that were actually put into the sewers through macerators.

While the amount of tomatoes packed during the 1940 season was large, the 4,000 tons contributed a B.O.D. load of only 624,000 pounds for the entire season, an amount hardly significant when compared to that from the peaches and pears. None of the other products canned in the East Bay are of sufficient quality to cause concern when compared to the loadings at the peak of the peach season. Macerated asparagus waste can cause a noticeable and objectionable mat of fiberous waste material when dumped into water courses without treatment. About half of the entire input to the plant is ground for disposal through sewers or hauled away as a garbage waste. If waste from all of the asparagus packed in the East Bay in 1940 were macerated, the sewage load from the 3,456 tons packed would be only 250,000 pounds of B.O.D., distributed over a four months season. Actually, a large portion of the waste was hauled away and the loading was reduced by almost the same proportion, as all of the waste from the asparagus canning season, exclusive of macerated trimming, produced only about 13,400 pounds of B.O.D. for the season.

Some attempts are made at treating cannery wastes. A plant handling peaches and pears screened its wastes. Water carriage of all the solids was used, and the waste from the peach plant and from the pear plant were combined after straining out the larger pieces of pear peeling through a ⅛ inch slotted screen, and the peach particles through a one inch bar rack. The combined peach and pear waste was then screened through a ten mesh vibrating screen. The efficiency of the screen in the removal of B.O.D. and suspended solids was 20% and 18% respectively. Observation of the screening process showed that a great deal of the smaller material went through the screen.

Previous tests made on waste from the lye peeling of peaches indicated that the bulk of the solids passed a No. 48 Tyler Standard Screen while 75% of the solids were retained on a No. 65 screen.

Wastes from pears can be kept out of the sewers without too much difficulty. One plant in the East Bay keeps all pear waste out of the sewer and has it hauled away as garbage. Another plant carries it from the peeling machines on an endless belt conveyor leading to a macerator. Other places haul the wastes to the macerator in boxes. To keep the peach or pear trimmings out of the sewer is more a question of economics than of engineering. Peach waste coming from the lye peeler, however, is definitely liquid, and must be treated as such.

Tomato wastes are screened by one company. A 40 mesh drum type screen removes 77% of the suspended solids, but the solid matter removed is so wet that subsequent removal of the excess liquid returns enough solid matter to the sewer to give an overall efficiency of 58% removal of suspended solids.

Another cannery cyclones all of its tomato waste through a 1/8 inch cyclone. This removes the skins and purees all of the tomato pulp, which goes to the sewer.

Industrial management often believes that they have no liquid wastes. "Nothing goes down the sewer except dirty water," is a common remark. That statement was made in all sincerity by the manager of a tannery, and again at a meat packing house. In general, managers of canneries and fish reduction plants appreciate the importance of the industrial waste problem, probably because of the vigilance of the Fish and Game Commission.

Managers and superintendents are often interested in the ultimate disposal of the wastes after they leave their plants. One superintendent was quite curious about the sewer into which the wastes from his plant were going. He dropped his voice and asked in a confidential manner if "bathroom sewage" was allowed in that sewer. When I told him it served about 40,000 people, he said that he had gone to the beach to see if the wastes from his plant were creating a nuisance and had gotten something on his shoes that was certainly not cannery wastes.

Another manager became interested in the amount of water he was using and had his two wells equipped with meters. One of the meters registered backwards a good part of the time, and on investigation it was found that one of the check valves had failed and water was being pumped out of one well and down into the other one.

Sampling techniques must vary with each industry. Wastes vary from the uniform spent media from growing yeast to the intermittent, varying discharge from a creamery. Sampling and measuring cannot be standardized. The important point is to get a truly representative sample of the waste from a known amount of industrial activity. To get this sample from most industrial wastes and from all domestic sewage, it is necessary to composite small quantities of the waste over a long period of time. All of the wastes having variable flows or

strengths were gauged for quantity and sampled at regular intervals in proportion to the amount of waste discharged.

Methods used by the survey to measure the quantity of wastes included:

Passing dyes and oats through a known channel.
Actual measurements of vats.
Water meter readings.
Timing the filling of a sump or bucket with a stop watch.
Gauging the amount of water pumped during the day.
Measurement of flow over a 90° V-notch weir.
Measurement with a Palmer-Bowlus flume.

Most of the measurements were made through a Palmer-Bowlus flume or over a V-notch weir. For industrial as well as domestic waste flow measurements, the Palmer-Bowlus flume meets all ordinary demands and eliminates all ordinary objections. It is so constructed and installed that solids are passed readily, normal flow is only slightly altered, and a rating curve of exceptional accuracy can be computed without aid of any empirical co-efficients or without need of individual calibration of each flume.

The V-notch weir has one major objection. Sediment and sludge collect behind it in great quantities and make proper sampling at the point of measurement difficult. Where this type of measurement was used sampling was done upstream from the weir a sufficient distance to allow normal velocities of flow. The V-notch weir is easy to maintain. No debris was found hanging over the weir plate during the survey. Rating curves can be computed by using well established empirical formulae.

Sampling of industrial wastes is not exactly a white-collar job. The necessity of going down a manhole receiving wastes from a meat-rendering works presupposes the need for a strong stomach. Preliminary investigation and interviews are not without their hazards. A pipe carrying "stick liquor," the waste from fish-rendering, broke while I was visiting the plant and I got a fish shampoo, and a dash of stubbornly clinging perfume that resisted all cleaning efforts for weeks.

The studies made in the field and the results from the laboratory had to be grouped and totaled before the results were usable. The first step was to reduce the data to terms common to all sewage, such as: pounds of bio-chemical oxygen demand, pounds of suspended solids, and pounds of grease for each unit of industrial production. These data are shown in their reduced form in the accompanying table, together with a compilation of other similar data gleaned from the literature.

To determine the total effect of these wastes upon the strength of sewage produced in the East Bay, the census of local industry was used. First the average daily contribution of domestic wastes was computed for every sewage shed in the survey, and expressed in terms of pounds of B.O.D., suspended solids, and grease. Added to this was the average daily contribution of each non-seasonal industry

in the corresponding area, expressed in the same units. Assuming that these quantities remain constant throughout the year, the daily load for the seasonal industries was added day by day until a complete record of sewage fluctuations was obtained for each of the present sewage sheds.

Twenty-four different combinations of the various sewage sheds were studied. To determine the probable plant loadings for each combination it was necessary to add the daily loadings from all of the sewage sheds in each combination, taking into consideration the daily fluctuations of the seasonal industrial wastes. The almost overwhelming number of calculations used to get the seasonal distribution of the loadings reduces graphically to a rather clear diagram of the sewage load that would be placed on a plant if one were to be built.

Designing a sewerage system for today would be rather short sighted. Designing for 1965 is much more practical, yet to design for the future somebody has to do some guessing.

Unless drastic changes in the mode of living take place in the next few decades, it is reasonable to assume that the amount of domestic sewage will increase in proportion to the increase in population. Population predictions made in the past have, in a great many cases, proved too optimistic. That the continued geometric increase in population assumed in many of the earlier predictions neglected the aging of the nation has been brought out by Veltz[1] in his paper on "How Old Are Our Cities." Recognizing the existence of a saturation point for the East Bay, estimates of the probable population and the rate at which it may be attained, were made for each census tract in the East Bay. Rates were assumed that took into consideration the decellerating effect of approaching saturation.

Industrial wastes are a more complex variable. Population increase, we know, will increase the amount of industry. That industrial establishments have, within the past several decades, increased much faster than the population, is well established. That only a portion of industry contributes an appreciable amount of industrial waste is also accepted. With these basic facts in mind, an index of the growth of industries producing liquid wastes was sought. A study of all the available data from the Census of Industry, and other sources, indicated that with the exception of the meat industry, the general index of industrial production in the United States represented the growth of the waste producing industries. Close scrutiny of the per capital rate of growth of industrial production indicated that a maximum rate of growth had been reached by 1929, and that beyond that date the normal rate of growth should decrease. An other interesting observation is that although depressions have occurred from time to time, the recovery has been so complete that the industrial production in years following the depression has in no way reflected the effect of the lean years. If the assumptions that the rate of growth will vary in the manner indicated is correct, the

[1]Civil Engineering, Vol. 10, pp. 619-622.

per capita production of industry throughout the United States was only 50% of its ultimate in 1929.

As sewerage must be designed for the peak loads, this trend of per capita production was projected to 1980, and expressed as an index with 1940 taken as 100. Similarly, the indices of meat consumption and of population growth were projected with 1940 considered as 100. These indices were plotted on the same sheet.

To predict the industrial activity of the East Bay at any date it is necessary only to multiply the index of population growth by the index of per capita industrial activity. The figure so obtained divided by the product of the indices at the date to which comparison is being made shows the increase in total industrial activity. Thus it appears that while the population of the East Bay in 1965 will be only 1.6 times what it was in 1940, the industrial production will be more than twice that of 1940. The decreasing per capita consumption of meat is overbalanced with the increasing population to give a predicted 1965 consumption of 1.4 times that in 1940.

Carrying all of these predictions through to an estimate of the probable amount of bio-chemical oxygen demand, suspended solids, and grease, a design estimate of a total B.O.D. load of 204,200 pounds per day, and corresponding loadings for suspended solids and grease were obtained. These values represent the predicted contribution of 768,600 people and the industry that they operate.

For comparative purposes only, it is interesting to note that the sewage, including industrial wastes, from an entire community of less than 800,000 people is expected to be equivalent to the sewage from the residences of 2,000,000 people; in fact, it may be stated that the industrial waste contributed for each person in 1965 will average 50% more than the waste contributed directly by that person.

SUMMARY OF INDUSTRIAL WASTES CHARACTERISTICS SUSPENDED SOLIDS, BIOCHEMICAL OXYGEN DEMAND AND GREASE POPULATION EQUIVALENT

Values after Items shown in Black Face Type in the "Description of Waste" and "Unit" Columns were obtained by this Survey; other values taken from the literature as noted.

DESCRIPTION OF WASTE	UNIT	Water Cu. Ft. per Unit	5-Day B. O. D. Lbs. per Unit	S. S. Lbs. per Unit	Grease Lbs. per Unit	Pop* Equiv.	Ref. No
Automobile Assembly							
Air Conditioning Wash	100 Cu. Ft. Water	100	0.85	0.60	0.19	8	1
Fruit and Vegetable Packing							
Apricots (Lye Peeled)	1 Ton Fruit	335	7.90	.....	....	76	40
Apricots (No Lye)	1 Ton Fruit	335	4.16	5.41	....	40	40
Asparagus (No Trim)	**1 Ton Asparagus**	845	3.9	1.6	0	38	2
Asparagus(Trim Macerat'd)	**1 Ton Asparagus**	1020	73	76	4.4	700	3
Cherries (Dyed)	1 Ton Fruit	405	17.2	4.5	.....	165	6
Figs	**1 Ton Fruit**	177	2.44	0.98	.....	23	7
Hominy (Corn)	**1 Ton Corn**	1480	42.6	94	.1	410	4
Corn Products	1 Ton Corn	1600	19.5	30	.....	186	41
Olives	**1 Ton Olives**	790	222	4.34	9.1	2130	5
Peas (Shelled)	100 Cu. Ft. Waste	100	8.75	....	.....	84	50

SUMMARY OF INDUSTRIAL WASTES CHARACTERISTICS

Values after Items shown in Black Face Type in the "Description of Waste" and "Unit" Columns were obtained by this Survey; other values taken from the literature as noted.

DESCRIPTION OF WASTE	UNIT	Water Cu. Ft. per Unit	5-Day B. O. D. Lbs. per Unit	S. S. Lbs. per Unit	Grease Lbs. per Unit	Pop* Equiv.	Ref. No.
Peaches & Pears(with trim)	**1 Ton Fruit**	189	15.2	15.0	.....	145	8
Peaches (Macerated)	**1 Ton Macerated**	.....	60	54	.....	580	9
Pears (Macerated)	**1 Ton Macerated**	.....	50	90	.....	480	11
Peach Waste	**1 Ton Fruit**	358	56.8	13.4	.....	550	11
Pear Waste (with trim)	**1 Ton Fruit**	175	52.4	72.9	.....	500	11
Pear Waste(after 1/8" screen)	**1 Ton Fruit**	175	24.7	13.1	.....	240	11
Peaches and Pears—							
Strained Waste	**1 Ton Fruit**	282	43.8	13.4	.....	420	11
After 10 Mesh Screen	**1 Ton Fruit**	282	35.0	11.1	.....	340	11
Peaches	1 Ton Fruit	348	29.2	13.0	.....	280	40
Tomatoes (Solid Pack) (Waste Cycloned 1/8")	**1 Ton Fruit**	30.3	8.42	2.88	.....	82	12
Tomato (Catsup)	**1 Ton Tomatoes**	187	11.23	7.05	2.3	108	13
(Thru 40 Mesh Screen)	**1 Ton Tomatoes**	187	7.70	2.96	.....	74	13
Tomatoes(No skin or pulp)	1 Ton Tomatoes	60	25.0	27.9	.....	240	42
Tomatoes	1 Ton Tomatoes	481	29.7	8.1	.....	290	40
Spinach (No trim)	**1 Ton Spinach**	660	22.2	18.9	0.8	210	14
Spinach (Macerated)	**1 Ton Macerated**	.....	70	114	.....	670	15
Spinach	1 Ton Spinach	1080	49.4	6.1	.....	470	40
Sweet Potatoes	**1 Ton Potatoes**	470	8.7	178	1.0	84	16
Dairy Products—							
General Creamery	**1000 Gal. Milk**	1480	101	50	9.7	970	17
Milk Processing	1000 Gal. Milk	928	318	.....	.....	3030	51
General Creamery	1000 Gal. Milk	1470	107	.....	13.3	960	48
Dried Fruit—							
Prune Tenderizing (Continuous flow)	**1 Ton Prunes**	25	3.1	1.6	0.3	30	18
Prune Tenderizing	**1 Ton Prunes**	4	2.0	0.33	.....	19	19
Fermentation—							
Brewery	**1 Barrel Beer**	27.2	1.24	0.62	0.022	12	20
Brewery	1 Barrel Beer	20.3	0.42	0.08	.....	4	41
Brewery	1 Barrel Beer	42.8	3.1	1.7	.....	30	44
Brewery	1 Barrel Beer	138	4.5	2.2	.....	43	45
Brewery	1 Barrel Beer	.....	.....	.....	.....	11-18	43
Yeast	**100 Cu. Ft. Waste**	100	33.7	Trace	.....	320	21
Yeast	**100 Cu. Ft. Waste**	100	15.4	Trace	.....	150	21
Yeast	100 Cu. Ft. Waste	100	43-86	.....	.....	410-820	43
Spirit Vinegar	**100 Cu. Ft. Waste**	100	106	18.2	.....	1020	22
Spirit Vinegar	**100 Cu. Ft. Waste**	100	68.5	15.3	.....	659	22
Spirit Vinegar	100 Cu. Ft. Waste	100	137	.....	.....	1300	43
Grain Products—							
Wheat Cereal	**1 Bushel Wheat**	0.88	0.77	1.92	0.0016	7	23
Laundries—							
Laundry Wash Water	**100 Cu. Ft. Waste**	100	1.45	1.72	1.28	14	38
	100 Cu. Ft. Waste	100	2.24	1.94	1.66	21	38
	100 Cu. Ft. Waste	100	6.03	2.12	1.72	58	38
	100 Lbs. Clothes	22.6	0.51	0.44	0.38	5	38
	100 Lbs. Clothes	13.8	0.83	0.29	0.24	8	38
Pigment Manufacture—							
Pigments	**1 Ton Product**	608	9.85	0.49	.....	950	24
Potato Products—							
Potato Chips	**100 Cu. Ft. Waste**	100	8.41	14.0	1.50	80	25

SUMMARY OF INDUSTRIAL WASTES CHARACTERISTICS

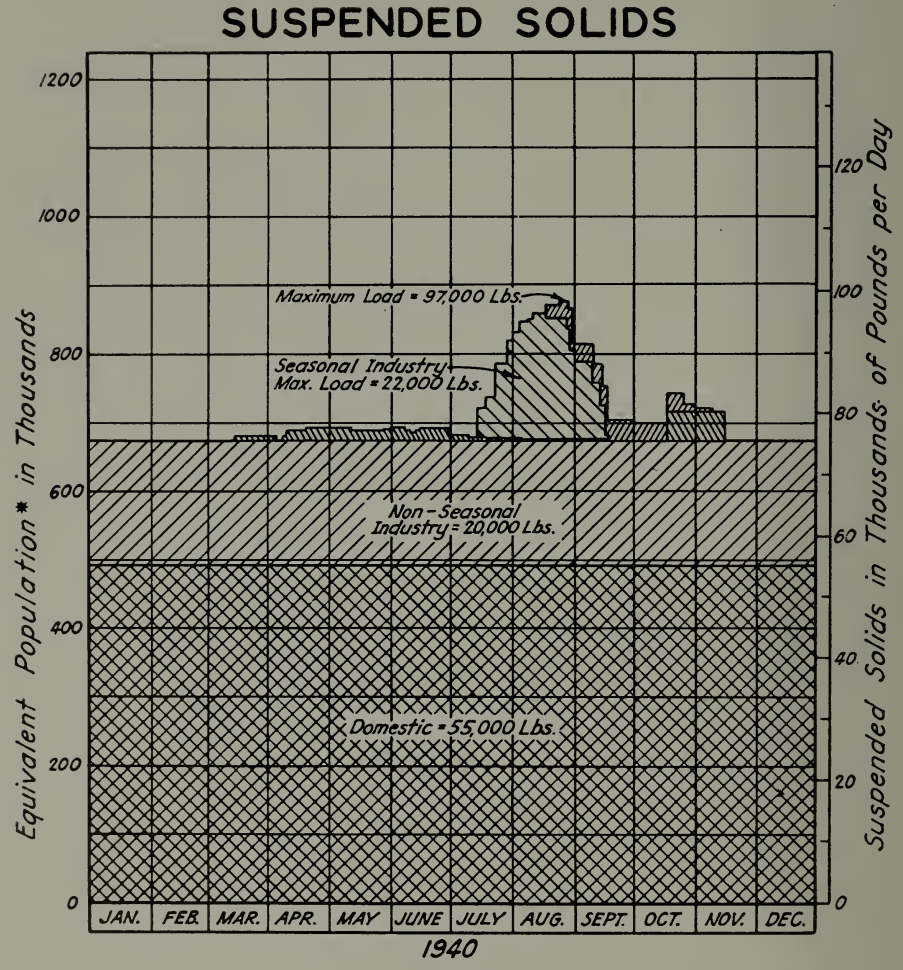
DESCRIPTION OF WASTE	UNIT	Water Cu. Ft. per Unit	5-Day B. O. D. Lbs. per Unit	S. S. Lbs. per Unit	Grease Lbs. per Unit	Pop* Equiv.	Ref. No.
Roofing Paper—							
Rag and Paper Felt	1 Ton Product	3170	18.2	75.7	1.98	176	26
Rag and Paper Felt	1 Ton Product	16.8	3.14	49.2	2.81	30	27
Paper Board	1 Ton Product	4810	18.2	144	8.89	175	48
Slaughtering, Meat Packing, Rendering—							
Cattle Slaughtering	1 Animal	38.0	1.85	1.30	0.51	18	28
Hog Slaughtering	1 Animal	8.72	0.42	0.55	0.09	4	28
Sheep Slaughtering	1 Animal	7.32	0.28	0.19	0.04	3	28
Slaughtering	1 Animal	61.5	3.33	2.68	.....	32	41
General Packing House	1 Animal	80.5	5.38	3.37	.....	51	41
General Slaughter House	1 Animal	48.0	7.72	3.21	.....	74	41
Pork Packing	1 Animal	30.2	4.20	2.61	.....	40	41
Hog Killing	1 Animal	19.1	0.42	0.98	.....	4	41
Cattle Slaughter	1 Animal	52.9	3.79	3.11	.....	36	41
Lard and Sausage	1 Animal	5.9	1.51	0.89	.....	15	41
Pork Packing	1 190-Lb. Animal	16.5	3.04	2.91	0.13	29	46
Pork Packing	1 Animal	75	3.14	.....	.....	30	47
1563 Hogs 797 Cattle 34 Sheep	1 Animal	196	7.2	4.88	1.8	69	48
10262 Hogs 1652 Cattle 2295 Sheep	1 Animal	113	3.88	3.29	1.09	37	48
240 Cattle 520 Hogs 560 Sheep 240 Calves	1 Animal	12	0.67	0.41	0.13	6	52
Small Packing House	1 Equivalent Hog	131	1.01	3.25	1.2	10	48
Large Packing House	1 Equivalent Hog	96	3.30	2.80	0.92	31	48
Rendering (Meat)	1 Ton Meat Scraps	56.4	23.9	27.1	16.4	230	29
Rendering Meat	1 Employee Day	56.7	6.65	1.15	.....	63	41
Rendering (Sardines)	1 Ton Fish	6.9	14.5	6.0	0.9	140	30
Soap Manufacturing—							
Combined Waste	100 Cu. Ft. Waste	100	4.38	4.75	2.21	42	31
Combined Waste	1 Employee Day	147	2.74	77.2	.....	26	41
Tanneries—							
Hide Tanning	1 Cattle Hide	34.7	1.52	4.65	0.43	15	32
Hide Tanning	1 Cattle Hide	55.5	2.15	4.85	.....	20	49
Hide Tanning	1 Hide	36	3.18	.....	.....	30	41
Calf Skin Tanning	1 Skin	10	0.89	.....	.....	9	41
Sheep Skin Tanning	1 Dozen Skins	6	0.33**	.....	.....	3	41
Harness Tanning	1 Hide	51.2	4.50	.....	.....	43	41
Textile Industries—							
Wool Pulling	100 Lbs. Wool	476	35.1	22.5	0.87	340	33
Cotton Yarn Dyeing	100 Cu. Ft. Waste	100	14	0.15	0.62	135	34
Vegetable Oils—							
Acidulating Waste	1 Ton Oil	51.4	1.03	0.47	0.24	10	35
Vitamins and Biologicals—							
Vitamin B	100 Lbs. Product	35.2	155	.....	146	1500	36
Horse Bleeding	1 Horse	0.134	0.90	0.05	.....	9	37
Domestic Sewage— (Residential Areas) (No known industrial wastes)	Per Person per Day	3.73	.104	.107	.019	1	39

NOTES: * Based on a Per Capita Biochemical Oxygen Demand(5-day) of 0.104 pounds.
** Estimated from oxygen consumed values.

REFERENCES:

1. Contains particles of paint and dusts from paint spray and rubbing rooms.
2. Clear waste from washing and blanching Asparagus.
3. Clear waste with floating Asparagus fibers.
4. Soapy gray to yellow waste containing finely divided corn hulls and blancher wastes.
5. Watery brown brine from the curing of green ripe olives.
6. Wastes from the vats in which sulfur dioxide preservative is removed from cherries and the fruit is dyed red.
7. Waste in wash water and b'ancher waste.
8. Waste from lye peeler and macerated trimmings.
9. Macerated fruit, no pits.
10. Macerated cull pears, peelings, stems.
11. Peaches and pears canned in same plant. All wastes removed by water carriage. Pear peelings removed by ⅛" slotted screen; both peach and pear waste finally sceened through 10 mesh screen. Waste contains lye peeler waste and fruit juices.
12. All wastes pass through ⅛" cyclone, which purees all pulp and removes skins.
13. Tomato trimmings and pulp from fine cyclones. After passing 40 mesh screen waste is clear and contains finely divided solids.
14. "Soupy" green liquor from blanching or wilting of spinach.
15. Suspension of spinach prepared by grinding and adding water.
16. Ye'low-brown waste from lye peeling and blanching sweet potatoes.
17. General creamery wastes from pasteurizing and packaging milk in paper cartons, and manufacturinng ice cream and cottage cheese. Some milk is condensed.
18. Di'ute prune juice from prune washer or blancher operating with continuous discharge of waste liquor.
19. Prune juice from prune washing or blanching in liquor which is drained after about 38 tons are processed.
20. Wastes from washing brewery vats. No mash wasted to sewer.
21. Clear amber waste, spent yeast growing media.
22. Heavy brown waste from alcoholic fermentation of molasses.
23. Rich broth from cooked grain.
24. Supernatant liquor from precipitation and filtration processes.
25. White, starchy liquor from abrasive peeling and soaking of potatoes. Large particles removed by screening through ½" wire cloth.
26. Muddy waste containing finely divided rag and paper fiber.
27. Waste is a fairly thick suspension of mud and fiber discharged bimonthly to the sewer from a settling basin which clarifies water for reuse.
28. Slaughtering wastes only; no belly processing or packing at this p'ant.
29. Greasy, odorous wastes from gut washer and vapor scrubber.
30. Excess concentrated liquor after oil and meal is taken from cooked fish.
31. Contains small amount of soap and impurities from oils.
32. Composite waste from chrome tanning process.
33. Greasy waste from wool and skin washing after wool is removed from skin by sulfite depilatory.
34. No vat dyeing at this p'ant, no kier liquor waste.
35. Clear, amber colored, highly acid wastes from treatment of inedible vegetable oils.
36. Thick cereal waste from rice bran.
37. Waste is red blood cells remaining after removal of serum.
38. Wastes from washer drains. Composites of a'l suds and rinses.
39. Mean average daily values

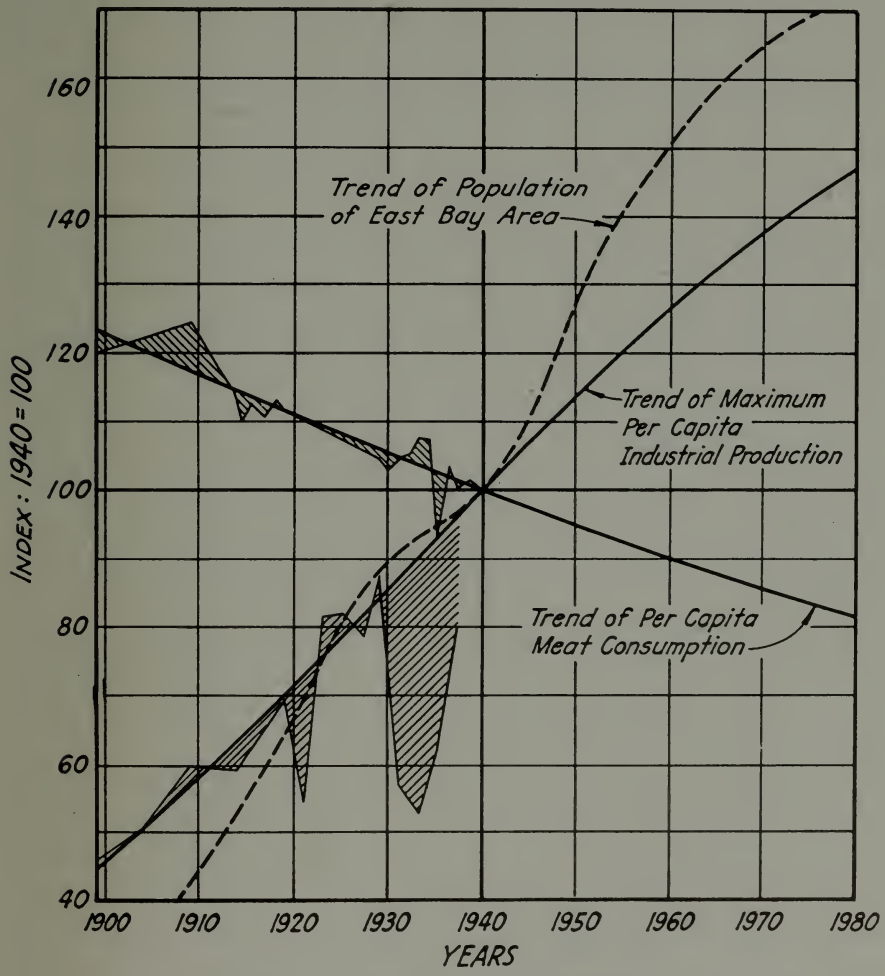
	Author	Publication	Vol.	No.	Page	Year
40.	Kimball, J. H., Gregory, T. R.	Sewage Works Journal	9	4	607-614	1937
40.	Kimball, J. H., Gregory, T. R.	Calif Sewage Works Journal	9	2	27-34	1937
41.	Hoskins, J. K. and others	U S.P.H.S. Bulletin No. 171			20-21	
42.	Hommon, Harry B.	U S.P.H.S. Bulletin No. 118				1921
43.	Bo'uff, C. S.	Industrial & Engineering Chemistry	31	11		1939
44.	Mohlman, F. W.	Modern Brewer	21		36	1939
45.	Stecher	Ges. Ing. (Munich)	62		394	1939
46.	Ramseier, R. E.	Report of Imperial County (California) Health Department)				1936
47.	Milling & Poole	Sewage Works Journal	10		738	1938
48.	Calvert, C. K. and Parks, E. H.	Sewage Works Journal	6	6	1159-64	1934
49.	Harnley, John W. and others	Sewage Works Journal	12	4	771-799	1940
50.	Kimberly, A. E'iot	Water Works and Sewerage	78	5	126-128	1931
51.	Montagna, Sylvan D.	Sewage Works Journal	12	1	108-111	1940
52.	Bowlus, F. D. and Banta, A. P.	Water Works and Sewerage	79	11		1932



Domestic
Non-Seasonal Industry
Tomatoes
Peaches and Pears
Miscellaneous Canning

1940 Population = 453,680
*0.107 Lbs. Suspended Solids per Capita per Day

PREDICTED 1965 PLANT LOADINGS		
CONTRIBUTOR	% INCREASE OVER 1940	MAXIMUM 1965 LOAD IN LBS.
DOMESTIC (POPULATION = 632,400)	33	73,000
NON-SEASONAL IND.	105	41,000
SEASONAL INDUSTRY	114	47,000
TOTAL	66	161,000



Trends for Per Capita Industrial Production and Per Capita Meat Consumption were determined by analysis of data contained in "Statistical Abstracts of the United States", Department of Commerce, Bureau of the Census, 1939, and in "Commodities in Industry", Commodities Research Bureau Inc., New York, 1940.

Trend of Population taken from Predicted Population of East Bay Cities (Table 30).

SEWAGE DISPOSAL PRACTICE AT MILITARY ESTABLISHMENTS IN CALIFORNIA

By E. A. REINKE* and J. W. PRATT**

GENERAL INFORMATION

Defense activity in California has precipitated many problems, one of the most striking being that dealing with sewage disposal for Army, Navy, and Marine Corps camps and bases, as well as for defense industries, housing projects, privately operated air schools, and what might be termed "satelite cities," whose almost spontaneous growth is the upshot of defense activities in their vicinities.

No record is available to indicate the total number of places in each classification. However, according to files of the Bureau of Sanitary Engineering, investigations have been conducted and advice rendered on sewage disposal for 48 government camps, 10 privately operated air schools, 8 housing projects, and 36 "satelite cities."

In a paper, "Recent Advancements in Army Sewerage Works," presented at the University of Southern California School of Government in June 1941, J. A. Harmon, Assistant Sanitary Engineer with the aforemention bureau, discussed the marked progress in sewage treatment methods adopted by the armed forces in the Spanish-American War, World War I, and in World War II. There were practically no treatment works or devices in use in 1898; the use of the Doten tank was more or less standard in 1917-1918, while there is a more general adoption of modern treatment methods in 1940-41. A few Doten tanks are still in service at Army camps in California; there are two at Fort Ord, one preceding a trickling filter at McClellan Field near Sacramento, a similar plant at Muroc Bombing Base in Kern County, and one soon to be abandoned ahead of a trickling filter at March Field in Riverside County.

In October 1940, following a call for bids by the Navy for the design of a sewage treatment plant at Camp Elliott to meet the "approval of state health authorities," the Bureau of Sanitary Engineering hurriedly set up minimum bases of sanitary design to guide bidders. These design bases were chosen on the assumption that in most instances a clarified, oxidized and chlorinated effluent would be needed and that plants would be in use only a few years. Capacities permitted of temporary overloading of certain units under peak flow conditions but this was offset by provision of ample chlorination equipment. It was not contemplated that these design bases would serve as a precedent for municipal sewage works but would satisfy the peculiar demands of the emergency.

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Shortly thereafter, Samuel A. Greeley, a sanitary engineering consultant for the Construction Division, Office of the Quartermaster General of the U. S. Army, visited California in connection with plans for sewage treatment at Camp Haan and was furnished with a copy of the Camp Elliott "Bases of Design." In December 1940 the Army consulting engineers Greeley and Hansen, and Metcalf and Eddy prepared a guide which was issued by the War Department "to be used by the War Department, the Constructing Quartermasters and the Architect Engineers, with due regard for such special conditions at any of the projects as may require adjustment of the general recommendations." Subsequently A. M. Rawn who succeeded the first engineering consultants prepared a more complete "Technical Bulletin" which was issued on April 23, 1941. The various bases of design are similar and in general provide for separate sludge digestion, oxidizing filters with rather heavy sanitary loadings, and chlorination. There is now quite a variety of sewage treatment works at the various camps—standard trickling filters, single-stage, high-rate, or biofilters, and two-stage biofilters.

FUNDAMENTAL DESIGN DATA

It should be noted that all of these projects have been constructed under emergency conditions and that fundamental data had to be assumed for purposes of design. In general, sewage flow was estimated at 70 gallons per capita daily with a peak rate of three times the average, or 210 gallons per capita daily. Raw sewage 5-day B.O.D. was estimated at 0.17 pounds per capita daily, suspended solids at 0.27 pounds per capita daily, and grease at 0.088 pounds per capita daily. Since these camps are generally planned for hardly more than five years occupation, a lower first cost with higher annual operating cost was more favorably considered than might be the case in cities, where the reverse usually holds preference. It followed, therefore, that a large percentage of the designs chosen utilized high-rate trickling filters, usually boifilters, there being eleven completed or under construction and seven proposed for military establishments in California.

FIELD STUDIES

The Bureau of Sanitary Engineering has field laboratory equipment transported by a station-wagon, which is used for testing the performance of sewage treatment plants. To date one standard filter, one single stage bio-filter, one two-stage bio-filter and one standard filter operated with recirculation to simulate a bio-filter, have been tested at camps. One two-stage bio-filter for a city was also tested. This field work will be continued as time permits.

Unlike most municipal plants, these begin operating at near-design load and it is therefore possible to check performance against design assumptions. (By way of comparison, cities usually have to wait several years before reaching design population.) Results of field observations are summarized in Table I.

TABLE I

	Design	Max.	Min.	Avg.
Sewage Flow g.p.c.d.	70 (avg.)	129	56	67
B.O.D. lb./cap./day Raw . . .	0.17	0.157	0.070	0.122
B.O.D. lb./cap./day - Final . .	0.008-0.017	0.027	0.008	0.016
Suspended Solids lb./cap./day-Raw	0.27	0.143	0.060	0.100
Suspended Solids lb./cap./day-Final	0.014-0.027	0.027	0.008	0.017
Chlorine Demand (Effluent) lb./m.g.	290*	357	27	148

*Capacity provided at 2 pounds per 100 men per day.

Population served by these plants varied from 1500 to 26,000 and sewage flows from 0.095 to 1.5 m.g.d. Sewage flows have been found to vary widely and to be subject to sudden peaks due to unusual occurrences such as break in water lines, dumping of laundry water, heavy use of showers, etc. Provision of showers, flush toilets and urinals, and lavatories apparently induces cleanliness among the forces, because daily peak flows occur in the morning from 6.00-8:00 a.m. and in the afternoon from 5:00-7:00 p.m., in the latter characteristic differing from domestic sewage flow. Large quantities of grease have been observed arriving at plants indicating a general practice at some camps of flushing accumulated grease to the sewer rather than removing it from grease traps near the kitchens. At some other camps very little grease or garbage reaches the plants indicating careful operation of kitchens and grease traps. At one camp large quantities of mud reached the sewer producing raw sludge with volatile content frequently below 50%. It was reported that men in this camp frequently take showers with shoes on as a convenient means of removing mud and dust.

This particular camp was constructed in mid-winter and sewers were laid in mud-filled trenches which probably resulted in entrance of mud into the sewer pipes. In addition, the rock employed in the trickling filters is poorly graded, decomposable granite, which is a source of considerable black sand in the digester.

BAR SCREENS

Manually cleaned bar screens with one inch clear openings have been provided at most of the plants. Screenings are collected in garbage cans and disposed of by burial. This has proved quite a chore, and at least one plant proposes installation of a screenings grinder.

COMMINUTORS

Army cantonments have not provided comminutors, but several have been installed at Navy camps.

BIOFILTRATION

Since so many bio-filters have been recently put into use in military establishments, we have concluded that it would be interesting briefly to discuss the bases of design and make a few observations on performance of plants of this type in California. As will be noted the design practice has been far from uniform.

Primary clarifiers have been designed to give 1.2 to 2.7 hours settling on raw plus recirculated flow with detention based on raw sewage flow varying from 3.1 to 8.1 hours. Overflow rates vary from 270 to 1300 gal. per sq. ft. per day for normal flow and from 810 to 1720 for peaks including recirculation. Sludge removal practice follows that used at civilian plants and varies with the volume of sludge and the age of the sewage. Scum removal is generally provided.

Secondary clarifiers are usually of the same size as primary units and differ in the omission of scum removal and sludge collecting mechanisms, the latter case prevailing where recirculation is from the clarifier. Common practice is continuously to pump liquor from the bottom of the final clarifier to the primary clarifier although in some cases intermittent pumping is practiced. In either case, all sludge transferred to digesters comes by way of the primary clarifier.

Primary bio-filters have been designed on a basis of 1.74 to 3.3 pounds per day of raw B.O.D. per cubic yard of filter rock if used as single-stage, complete treatment. If followed by a secondary filter, they are loaded to 1.17 to 4.9 pounds per day per cubic yard. The secondary bio-filter is usually a duplicate of the primary but receives a lower B.O.D. loading in the removal of which it is less efficient than the primary filter. Areas used permit rates of application of 10. to 75. m.g.a.d. to each filter including recirculation. Depths vary from 3 to 6 feet, the former being the most common depth. The tendency has been to use coarse rock varying in size from 2½ to 3½ inches on single-stage filters, and 1½ to 2½ inches on secondary filters. Distributors have all been rotary with large arms designed to handle the total recirculated flows. Clogging of filter rock has been occasionally reported. In the two outstanding cases observed it was most probably due, in one case, to overloading a deep filter by operating it as a high-rate filter, and in the other by presence of considerable fine gravel in the filter rock. Slime growths occur in all filters observed but with customary recirculation rates they are continually flushed off and cause little difficulty. These growths are particularly heavy on primary or single-stage units. Algae are generally found on the surface of matured filter beds, if not overloaded, and are almost always present on the secondary units.

Recirculation practice varies with design. In some cases pumps discharge recirculated liquor to the filters and in others to the clarifiers, while in a few cases it is possible to do either or both. Generally, however, the practice includes recirculation of clarifier effluent to the filter with the excess flow from the primary stage going to the secondary recirculating pumps and excess from the secondary stage going off as plant effluent. Overflow weirs or float-actuated valves are used to control flows. Recirculation rates including sewage flow vary from 2.5 Q to 8 Q when Q represents average raw sewage flow. The high peak flows, which may be accentuated when raw sewage is pumped, result in hydraulic conditions which have not always been clearly foreseen in design and plant operators have found it

necessary to regulate flows manually in some instances where the design contemplated automatic operation. Short circuiting through clarifiers occurs during peak flows, particularly for single-stage plants.

SLUDGE DIGESTION

Sludge digesters if heated have been designed for 2.5 cu. ft. per capita. Both single-stage and two-stage digesters have been used. Provision for sludge recirculation for seeding has generally been made. Supernatant liquor has been troublesome at several plants and it has occasionally been necessary to run it to sludge drying beds rather than return it to the primary clarifier. At one plant which was just recovering from upset conditions due to a foaming digester, it was estimated the organic and solids load from supernatant liquor were equivalent to half that of the raw sewage.

SLUDGE BEDS

Drained sludge beds have generally been designed to provide one square foot per capita. Undrained beds provide 3 square feet per capita. The latter should not be built in excavation where storm water would waterlog the ground, but if used should be in soil naturally underdrained.

CHLORINATION

Chlorination has been provided for odor control and for effluent disinfection. A capacity of 2 pounds per 100 men per day and a contact period of 30 minutes based on average sewage flow was recommended in the Camp Elliott "Bases of Design." Most of the installations have approximated these values for capacity and contact period. Program control is usually manual.

EFFLUENT DISPOSAL

Effluent disposal is to land at 15 places, to drains or dry washes in 5 places, and to streams in 5 places. Several of the older forts and military establishments on San Francisco Bay, Monterey Bay, and San Diego Bay discharge raw sewage directly to ocean and bay waters.

OPERATION

Pumping: In camps where raw sewage is pumped to the plant, clogging of the pumps by rags and other materials is experienced; the indicated alleviation of this seems to be more complete policing of sewer entries by camp sanitary officials and prevention of entry of such material into the sewers. Intermittent high-rate operation of raw sewage pumps results in momentary overloading of treatment units designed to accommodate the same daily total as an average, continuous flow.

Clarification: There are times when portions of the camp complement are withdrawn for either local field maneuvers or more distant operations, at which times the daily flow becomes a fraction of the normal. On such occasions the primary clarifier may suffer from blanketing of the raw sludge as an outgrowth of long detention and infrequent sludge removal. In such instances more frequent sludge

transfer to the digester is indicated to avoid incipient digestion in the clarifier.

Filtration: Another phenomenon noted on the occasion of absences of the forces from one camp was the effect of a high recirculation ratio through the single-stage bio-filter when raw sewage flow was low. With a theoretical eleven passes through the filter for each gallon of raw sewage, the production of nitrates was extraordinarily great, ranging from 40 to 75 p.p.m. in the plant effluent. Although indicative of substantial oxidation of the sewage, its consequences were apparent in the increased chlorine demand of the effluent. Initial dilute nature of the sewage obviated a high percentage removal of 5-day B.O.D. at this plant, but an effluent B.O.D. of 13 to 20 p.p.m. was produced on the basis of two 24-hour composite samples.

Sludge Handling: Sludge is normally pumped to the digester several times daily, usually once in the morning and again in the afternoon. In some cases the recirculation pumps are dual-purpose units also used for sludge. For cases of fluctuating population, frequency of sludge pumping should be correlated with detention time in the primary clarifier.

Sludge Disposal: Since most plants have been placed in operation this year, sludge drying and disposal have so far not received much study. Artificial seeding of new digesters has not been resorted to, thus initiating a period of maturing before gas production commences. Digesters sometimes have been artificially heated to accelerate gas production and digestion processes. Separate digestion is employed at most plants and at several includes gas collection for heating the digesters.

Chlorination. Chlorination practice focuses on the objective of an orthotolidine residual in the plant effluent of 1 p.p.m. after the usual 30 minutes contact. As most of the plants have no facilities for performing the chlorine demand test, this requirement is rather loosely adhered to. In several instances the presence of nitrates in filter effluents is known to interfere with the colorimetric test for chlorine. It is believed that chlorine consumption sould be reduced by securing chlorine demand schedules throughout the day. Present methods are to apply gas at near-maximum machine capacity during the day and to manually adjust the dose downward at night and in the early morning. Local health department officials prefer an overdose of chlorine until actual demands and fluctuations in sewage flow are better known.

Personnel: There is obviously a growing need for trained operators in such a multitude of plants. So far this has been met, in part, by attracting experienced men from municipal or civil service. In many cases the operators have had little or no prior experience in sewage treatment, nor have they been given any information concerning the purposes and function of the several units in the treatment process. Even the experienced ones are sometimes unfamiliar with the type of plant they have been assigned to operate. Hence, just as a consulting engineer has been retained during the design and

TYPES OF SEWAGE TREATMENT WORKS AT DEFENSE TRAINING CENTERS IN CALIFORNIA

	Septic Tank	Doten Tank	Imhoff Tank	Clarigester	Separate Sludge	Trickling Filters			Chlorination	Sand Bars
						Standard	Single Biofilter	Two-Stage Biofilter		
Airlight Naval A. S.	x U									
Alameda Naval A.S.					x		x		x	
Camp Callan					x		x		x	
Camp Elliot					x				x	
Camp Haan					x			x	x	
Camp Lockett			x			x			x	
Camp Marysville					x P		x P		x P	
Camp McQuaide	x								x	
Camp Roberts					x			x	x	
Camp San Luis Obispo					x	x			x	
Camp Victorville				x			x		x	
Chino Cal Aero School			x							x
Fallbrook Munitions Dump	x U									
Fort Ord-East Garrison		x								x
Fort Ord-Main Garrison		x								
Fort Ord Village					x		x		x	x
Fresno Airport				x			x		x	
Hemet-Ryan Airfield	x U									
Hueneme Naval A. S.	x U									
King City Airport	x U									
Lemoore Field				x P			x P		x P	
Lerdo Airport										
Los Alamitos Airfield					x P			x P	x P	
March Field					x			x	x	
Marine Rifle Range	(x)				x P	(x)	x P		x P	
Mather Field				x			x		x	
McClellan Field		x				x			x	
Merced Field				x			x		x	
Moffett Field	x									
Muroc Bombing Base		x				x			x	
Oakland Navy S. D.			x P						x P	
Paso Robles Airfield			x						x	x
Polaris Airfield				x			x		x	
Quinn Air School	x U									
Roosevelt Fleet Base					x					
Salinas Ariport	x U									
San Bernardino Airport	x U									
Santa Maria-Lompoc (Camp)					x P		x P		x P	
Sub Moffett Field			(x)	x P		(x)	x P		(x)	
Taft Airport				x			x		x	
Tex Rankin Air School	x U									

(P. 44) P—Proposed U—Underground disposal of Effluent (x)—Existing Works

construction, so it would seem desirable for the operating authorities to acquire the services of an experienced adviser on operation. Since most of the plants are highly mechanized and automatically controlled, education in a few details would perhaps iron out the few remaining kinks in operation.

CONCLUSIONS

In general, the Bureau of Sanitary Engineering concludes that sewage treatment works as designed for military establishments in this state, while not conservative, are along the same lines as those provided at municipalities constructing new plants in similar locations, and that health and comfort of civilian population have been considered in choosing types of plants and location of works. Furthermore, operating experience gained in such instances will be of further value to military and civilian authorities alike.

Acknowledgement is made to the designing engineers, plant operators, and Army, Navy, and Marine Corps authorities, whose desire for this sort of information has culminated in the foregoing observations.

In Memoriam

John Jacobson, born in Preston, Iowa, August 11, 1884, served in the United States Navy while still a very young man. Shortly after receiving his discharge from the Navy he went to Davis, California, as foreman of a construction crew to build the first sewage disposal plant and water storage tank on the University Farm Campus (1907). About a year and a half later he became an employee of the University of California at Davis and from a one-man trouble shooter for all utilities and construction work on the campus advanced to Superintendent of Construction and Repair with approximately fifty men under his supervision. Due to his efforts a merit plaque was awarded to the Davis Campus in 1929 by the California Sewage Works Association for efficient operation and good appearance of the Sewage Disposal Plant. He was affiliated with the Association for several years and was an active member at the time of his death on August 15, 1941. Mr. Jacobson was President of the Association in 1933. "Jake" as everyone called him was a public spirited man and served his community in various civic capacities during his 33 years' residence in Davis. Mr. Jacobson married Esther Maxfield shortly after arriving in Davis and six children were born to this union, all of whom were left to mourn his passing.

THE EVALUATION OF SEWAGE TREATMENT

By W. J. O'CONNELL SR.*

Engineers and technicians recognize evaluation to be a mathematical term so "Evaluation of Sewage Treatment" might identify comments on accurate analysis of operations. Instead, this paper summarizes discussions between the author and Messrs. Kennedy, Gillespie, Reinke, Rawn, Gray, Hyde, Ingram, Travaini, Benas, Fraschina, Roberts, Carollo, Shearer, Allen, Goudey, Ludwig, Banta, Castro, Kelly, Harvill, Scott and others.

Discussions started with observations that special limitations are imposed on every plant by reason of particular geographical location, seasonal changes, urban habits, industrial development, collection system characteristics, disposal plant design, capacity of treatment units and provisions of flexibility. Of course, many authorities have indicated that characteristics of those limitations should be established before proceeding with comparisons of performance at several plants. Comments, tables and graphs appearing in sections of "Modern Sewage Disposal" by Messrs. Greeley, Stanley, Mohlman, Donaldson, and Holmquist, are pertinent. (1, 2.)

The group has expressed common interest in efforts to develop more fundamental expressions of work accomplished in specific plants and has expressed interest in efforts to establish more accurate means for comparing plant performances.

More specifically, the author is interested in evaluating occasional chemical treatment or additional chlorination as an accessory means of improving the performance obtained in particular plants, and has tried to develop quantitative expressions of "work" done at intervals when influent flows and loadings are of such nature that effluent of low quality is produced. "Work" is used in the physical-mechanical sense of "accomplishing physical change of definitely measurable quantity."

Nearly all usual tabulations of comparative performances include statements on plant classification as to type and flow handled, as well as solids concentrations in, and B.O.D. of, influent and effluent flows. However, complete understanding of variations in performace is dependent upon evaluation of quantity and character of input loading in relation to "flowing thru periods," the nature of loading variation and the theoretical maximum removals for various types of input loading at calculated detention of flows.

Indices and ratio expressions in common use do not measure the work accomplished in, or the performance of, treatment plants.

The assembly of thoughts on "Evaluation of Sewage Treatment" includes a loose usage definition of the term with leeway for consideration of the broad aspects of public health, sewerage and disposal undertakings.

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Technical workers find more use for the mathematical definition of "evaluating" as meaning "to work out the value of; to find a numerical expression for; to reckon up; ascertain the amount of; to express in terms of the known."

"Evaluation of Sewage Treatment" is a matter of abstract relation. (4, 5.) Thus, conclusions drawn from discussions of this problem are subject to question unless definitions of terms are established beyond possibility of confusion. (6.)

Many terms used in expression of "plant performance" are assembled from the language of engineering and laboratory practice. Operating reports are replete with such examples as "design capacity," "cost per million gallons," "per cent reduction," and "parts per million." These terms are essential to exchange of knowledge among designers and technicians, and are invaluable to engineers. Long and extensive application of these terms gives each an important function in procedures used by consultants when checking recommendations. However, they are not "expressions in terms of the known."

Of necessity, engineers facilitate their thinking by referring to ratios, similarities, and experiences since opportunities to demonstrate characteristics of sewage flow and strength in particular situations, prior to detailing treatment plants, are so rare.

Of necessity, engineers use mean, average, and maximum figures in tabular or graphic presentation of their opinions on probable performance of projected plants under a wide range of loading conditions. References to "design capacities" are conveniences to discussions involving the "buying public." It happens that "design capacities" of central generating stations and limited types of industrial plants can be specified with considerable accuracy, so the public expects use of this term in sanitary practice in a comparable sense.

Similarly, the nature of capital and operating expenditures is indicated by reducing the amounts to "cost per million gallons."

References to performance data in percentage terms do not impress a clear understanding of values in amount and kind of work accomplished during operation of sewage treatment plants.

The relation between shapes of load curves and variation in operating costs with variations in loading is stressed in analyses of central generating station operation. It is understood that comparisons of work done in, and costs accruing at, central generating stations will not be valuable unless each station listed is similarly loaded with respect to load factors and load curves. Peak loads on generators are determined over periods of 30 minutes to one hour and average loads are taken for one day, month or year. "Load factor" is the ratio of average power divided by peak power. "Load curves" are plotted with the kilowatt load for short time intervals as "ordinate" and the time intervals as "abscissas."

Studies of similar exactness are not anticipated as preliminary to expression of relationships between variations in disposal plant loadings, structural design of disposal plants, and operating performance.

Obviously, the simultaneous occurrence of many physical, chemical and biological reactions in major treatment processes so complicates the problem of demonstrating energy changes that accurate determinations of "work" are precluded. In general, the character of results obtained in these units vary with changes in time, temperature, and concentration factors. Thus, it is not equitable to compare or criticize the proficiency of plant operators except in respect to their ability to obtain maximum performance from widely variable sewerage systems having inherent and fixed limitations beyond control.

Interesting studies of treatment plant performance have been based on combined use of flow loading curves (typified in Figure 1), suspended solids loading curves (typified in Figure 1c), accumulated suspended solid curves (typified in Figure 2), and comparable curves relating to the quantity of effluent flow, suspended solids output, B.O.D., H_2S, and chlorine demand of increments of effluent flow, plotted against the time these increments of effluent arrive at the influent.

Graphic presentation of operating data in this manner shows characteristics of the effluent corrected back to identify increments of effluent with their position in graphs of plant loading. The true correction is made by subtracting the "flowing through period" from time and collecting the effluent samples.

Contrasting Figures 2 and 3, the first expresses quantities of suspended solids material being handled in an operating plant, while Figure 3 develops ratio data of value to the consultant on design of improved sewerage for the East Bay cities. (3.)

Figure 5 shows the curves of flow, H_2S concentration, and total H_2S loading on the effluent receiving stream. As curves 4 and 5 indicate, the plant receives sanitary sewage from an extended collecting system. In this case, it is a rather simple matter to approximate the "flowing through period" for increments of flow in respect to the rate of flow to the plant at any particular hour of a typical day.

Figure 6 shows the graph of the "flowing through period." Usual performance tabulations specify "detention time" under varying flow conditions. The "detention time" is a calculated value based on physical capacity of treatment units whereas the "flowing thru period" must be determined during operation. Direct use of the "flowing through period" curve is not sufficient for exact adjustment of the time ordinate to establish when increments of effluent flow arrive at the influent. The exact adjustment is determined by attention to the rate of change of "flowing through period" during the entire interval required for travel of the increment under examination.

The curve of H_2S quantity in Figure 5 is repeated in Figure 6. This data is then replotted to show the quantity of H_2S in the increments of effluent adjusted to the time of arrival of increments in influent.

Curve 6c is illustrative, not accurate, since it is developed by simple subtraction of flowing through periods as shown in curve 6a.

Figure 7 is a replotting of the final curves of Figures 4 and 6,

together with a plotting of the ordinate distance between these two curves at any particular time showing whether there has been a decrease in H_2S content, or an increase, or, in other words, an improvement or a degradation in flow quality, as indicated by changes occurring in the number of pounds of hydrogen sulfide in solution during flow of increments from the plant inlet to the plant outlet.

Such curves give one crude basis for establishing measurements of physical change in units or increments of raw material handled through disposal plants. The curves do not establish quantity measurements of "work" expended reducing or oxidizing sulfur. The curves show variations in quantities of H_2S being handled from hour to hour. However, quantity measurements of the "work" expended on changing sulfate and dissolved sulfide content (and producing the quantity of H_2S that has passed out of the sewage during treatment) must be included in calculations of work accomplished in reducing or oxidizing sulfur.

R. F. Goudey's reports on pioneer use of chlorination of H_2S control (7)[1] offer quantity estimates of H_2S loading and sulphul reduction in the El Centro sewers, based on determinations of changes in sulfate quantities during detention in the collection system.

In other words, even the illustrative curves of H_2S loading do not show the extent of physical change in respect to "work done" in one phase of treatment.

A. M. Rawn has called attention to the "levelling off" effect of plain subsidence tank effluent quality and to the capacity of treatment processes to absorb shocks. (8) Fair, Imhoff (9) and Ludwig (10) discuss evidence that the limit of solids removal by plain sedimentation is established by a curve varying between 200 p.p.m. suspended solids at about 1500 p.p.m. concentrations in the raw, and 60 or 70 p.p.m. suspended solids at about 200 p.p.m. concentrations in the raw. (Above illustrative of plain sedimentation reactions without preflocculation.) The zone of influent suspended solids concentration where the limit of solids removal changes rapidly coincides with the zone of suspended solids concentration for most raw sewages.

Expressions of the Richmond-Sunset Disposal Plant daily average performance as "percent reductions" show 77.8% removal when handling 18,000 pounds of solids and discharging 4,000 pounds of solids. (At one particular time,—the removal of less than yearly average percent reduction.)

At a period when the Tovrea Packing Co. Disposal Plant at Phoenix handled 250,000 gallons in a 12 hour period having average concentrations of 2770 p.p.m. suspended solids in the influent, the effluent produced averaged 160 p.p.m. suspended solids. The "percent reduction" expression of performance thru this plant indicates 94.3% removal. Actually, the plant appears to have removed 5416 pounds suspended solids per day and discharged 332 pounds. The design of the plant compares in type to the Richmond-Sunset Plant, excepting that flocculation is augmented by chemical precipitation at Tovrea and grease removal is effected by aeration at San Francisco. Thus,

we might erroneously conclude that the Tovrea Plant is a better plant that the Richmond-Sunset plant. On the other hand, if we imagine the Tovrea plant extended to handle 7.0 M.G.D. flows of their average strength packing house waste, it would be treating the gallonage passing thru Richmond - Sunset, would be removing 151,700 pounds of suspended solids per day and would be discharging 9300 pounds in contrast to the 4000 pounds discharged from Richmond-Sunet. In other words, a plant comparable to that of the Richmond-Sunset type can be used to attain about eight (8) times the quantity removed at present and will only discharge 2.3 times the quantity of suspended solid found in Richmond-Sunset effluent, all assuming the Richmond-Sunset plant located where an identical quantity of greater strength flow must be treated.

Early workers called attention to the quantity factor and tried to emphasize this factor with frequent conversion of data to statements of "equivalent population."

"Population equivalent" factors are not related to variations in treatment plant loading. More general use of "equivalent population" figures is recommended.

Graphic arrangement of information is essential to evaluation studies. It is hoped that more nearly mathematical expressions of performance will be established by workers interested in this problem. In the meantime, tabular, or "word pictures," of the differences between sewerage problems and their operating solutions can be indicated by a series of "population equivalent" expressions.

For the purpose of this discussion, it is not necessary or desirable to analyze the procedures used in developing terms to expand the meaning of "population equivalents." A separate discussion of methods used to establish the magnitude and variation in "population equivalents" pertaining to raw sewage flow and pertaining to maximum performance in the several type treatment plants in common use, is to be prepared with the cooperation of R. E. Ramseier.

The list of "population equivalents" can be exanded as follows:

"Population equivalent — flow"
" " — raw suspended solids"
" " — raw B.O.D."
" " — effluent suspended solids"
" " — effluent B.O.D."
" " flow — average 6 hours of minimum flow"
" " " — average 6 hours of maximum flow"
" " — average 12 hours of median flow"
H_2S per unit population — pounds in influent
" " " — pounds in effluent

If the values of the above expressions are agreed upon, after postulating the characteristics of average sewage flows, as, for example, 100 gallons per capita of 200 p.p.m. suspended solids, 250 p.p.m. B.O.D., and so forth, then a table of "equivalents" with respect to actual population can be prepared. The deviation of "population equivalent values" from actual population figures will indicate vari-

ations from "average sewage" and variations in plant loading. The data pertaining to H_2S quantities will show a measure of variation in age of sewage, that is, of the time interval obtaining in the sewerage system, (in localities where sewage contains sulphate).

It becomes increasingly difficult to express work accomplished by predominant biological reactions as indicated by Thierault (9) and others who have studied the steps of progressive exertion of the biochemical oxygen demand. It is entirely possible that variations in loading on a plant alter the extent of oxidation in respect to nearness to a nitrification stage.

"Time" may be the most important variant in the quantitative expressions of "work done in treatment plants." Again, control of time factors is dependent upon geographical location, seasonal changes, urban habits, industrial development, design of the collection system, capacity of treatment units, provision of flexibility. Certainly, latitude as to alteration of time factors is limited to manipulation of appurtenances, such as pumping stations on the collection system and use of any flexibility inherent in the plant design.

These illustrations—while taken from practice, are not presumed to illustrate performances obtained thru best use of modern type mechanically equipped units, but are offered to emphasize our contention that "efficiencies" expressed in ratio terms as, for example, "percent reductions," are directly related to loading, load factors and "flowing thru periods."

It is contended that "percent reduction" figures, as well as other ration and proportion terms, are questionable criteria of operations. It is contended, however, that we can establish numerical expressions "in terms of the known" that will give a better yardstick by which to measure proficiency in operation. It appears essential as a first step in the program that the meaning of terms used in the art be analyzed and clearly defined.

This entire presentation is an obvious admission that the author is unable to complete an all too ambitious program to evaluate sewage treatment.

More study on the problem is in progress and will be discussed. However, sound technical discussion depends upon a clear understanding of the tools used in our exchange of ideas—namely, words. Most glossaries (11) and definitions (12, 13) of terms pertaining to sewerage and sewerage practice are confined to a description of things, while understanding of terms of abstract relation, including quantity, order, number, time and change, is assumed.

The Association can facilitate discussion of many sanitary problems if it is willing to undertake the assembly of a dictionary of terms used in literature of sewerage practice including definitions of abstract relations and analytical tests.

Once the effect of limiting factors is established in respect to "work analyses," pertaining to operations at particular plants, operators may be able to justify requests for additional appurtenant

structures and for the programmed use of accessory processes, such as aeration, evacuation, chlorination and chemical coagulation.

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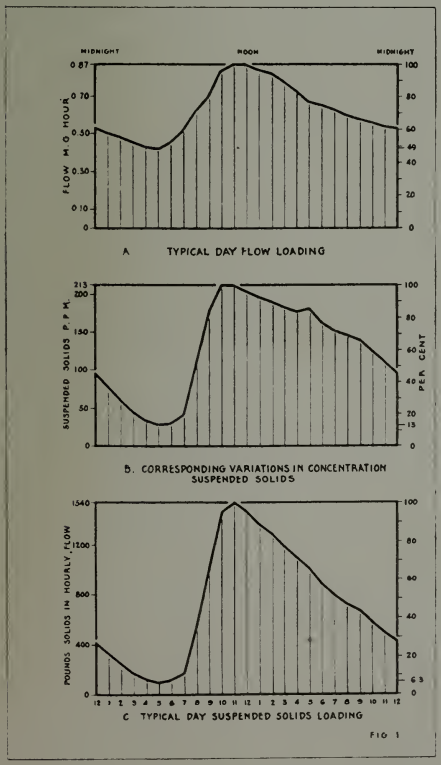
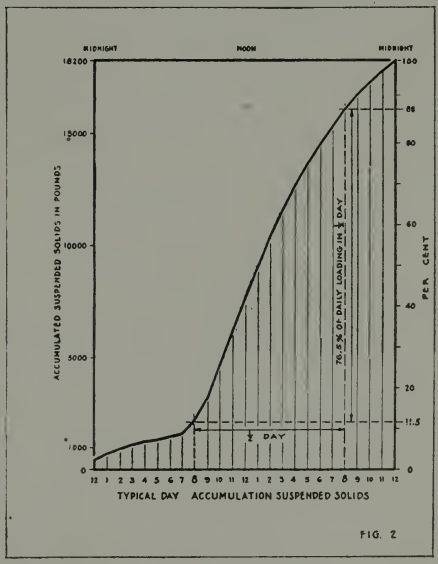
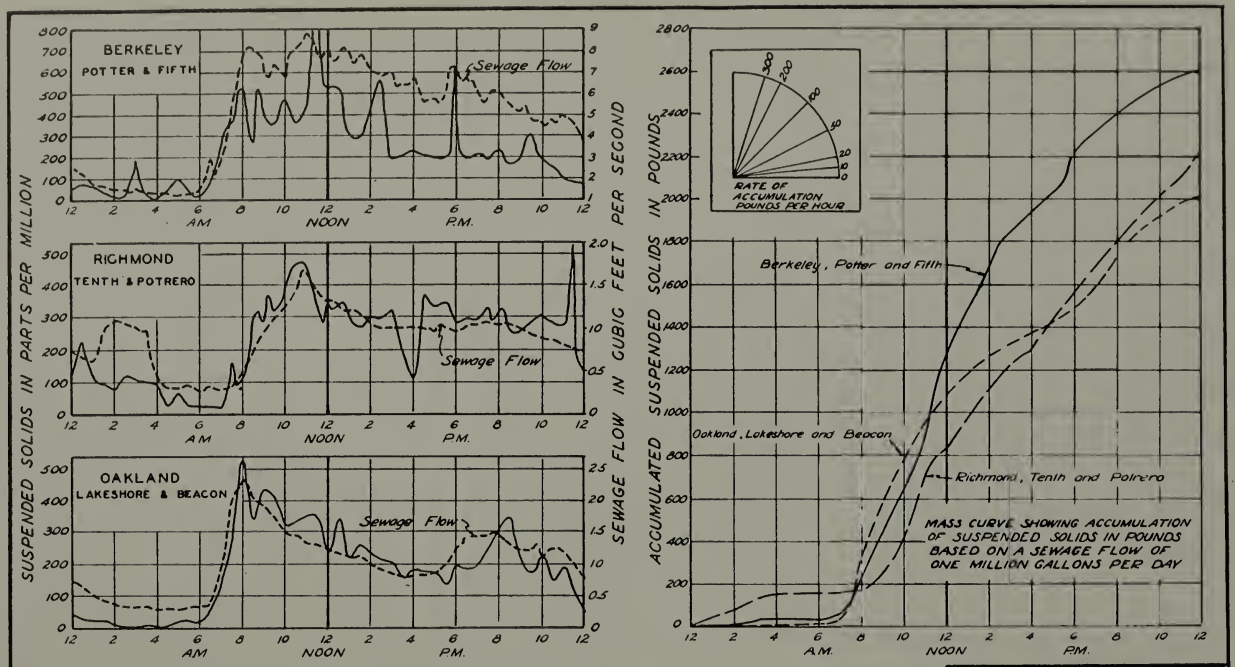
DISCUSSION OF MR. O'CONNELL'S PAPER

Mr. Pomeroy pointed out the complexness of evaluating plant influents and effluents due to low flows and to the influence on the retention time by cross-circuiting. Mr. Benas mentioned Rudolf's method of evaluation by the size of particles in the sewage, where limits will be a certain definite size. Mr. Ludwig stated that it was very difficult to determine the size of organic colloids as their size is increased by flocculation and other processes. Mr. O'Connell said that his paper was intended as a statement of a crude method of evaluating sewage treatment and that it would be up to the operators and chemists to continue on from that point. Mr. Reinke advised the members to read the paper after it is printed and prophesied that it would be read for years to come. He stated that Mr. O'Connell's method provides words for expression of conditions that are now

inexpressable but that the method will require thought before it can be used. Mr. Pomeroy stated that all evaluation depended upon chemical tests and warned that too much faith should not be placed in test results. He exemplified his statement by the fact that different results can be obtained in the suspended solids test depending upon whether the asbestos or the filter paper method is used. Mr. Keirn called attention to the fact that at the Niagara Falls Plant the records show only 10% removal of solids but the maximum possible reduction was only 11 or 12% thus indicating that the plant was doing the work for which it was designed. President Gray stated that the design of plants should be judged by the total poundage removed rather than by the actual end product produced. Mr. Parks ended up the discussion by stating the need for a universal language to be used in the sewage works field.







FLOW AND S.S. DATA			
City	Berkeley	Richmond	Oakland
Location	Potter and Fifth	Tenth and Potrero	Lakeshore and Beacon
Date	Oct 21-22 1940	Oct 9-10 1940	Oct 2-3 1940
Period	5:30 p.m. 5:30 p.m.	5:00 p.m. 5:00 p.m.	7:30 a.m. 7:30 a.m.
Total Flow MGD	3.330	0.578	0.665
Total Lbs susp. solids/M.G.	2,599	2,204	2,011

Note:

The values for Potter and Fifth Streets, Berkeley, include wastes from connery and vegetable oil industries.

The values for Tenth and Potrero, Richmond, are for a domestic sewage. There are two pumping stations on the sewer system.

The values for Lakeshore and Beacon, Oakland, are for a domestic sewage from the better type of residential area.

Suspended solids are those retained by Whatman No. 40 filter paper.

The weights given in pounds are computed on dry basis.

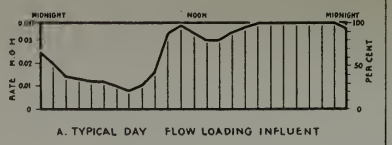
See Tables 32; 33; 34

EAST BAY CITIES
ALAMEDA ALBANY BERKELEY EMERYVILLE OAKLAND PIEDMONT RICHMOND
SEWAGE DISPOSAL SURVEY
BOARD OF CONSULTING ENGINEERS
CHARLES GILMAN HYDE A. M. RAWN
HAROLD FARNSWORTH GRAY

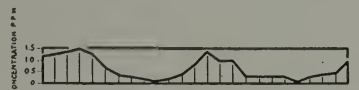
SUSPENDED SOLIDS
VARIATION AND ACCUMULATION IN A 24 HOUR PERIOD

DRAWN BY	CHECKED BY	APPROVED	DATE	PLATE NUMBER
N.L. - F.D.	N.D.A.	R.R.B. C.G.H.	6/30/41	70

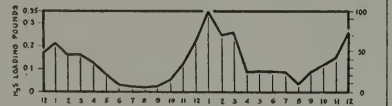
FIG. 3



A. TYPICAL DAY FLOW LOADING INFLUENT

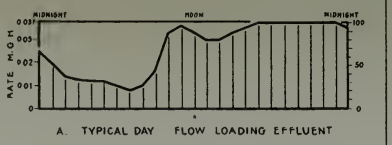


B CORRESPONDING VARIATIONS IN CONCENTRATION H_2S

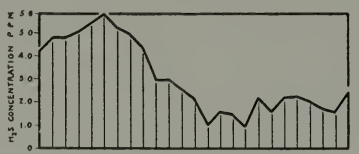


C. TYPICAL DAY H_2S LOADING INFLUENT

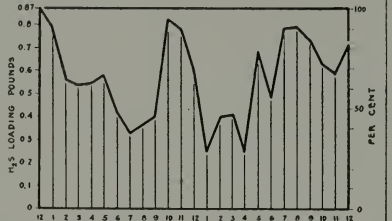
FIG 4



A. TYPICAL DAY FLOW LOADING EFFLUENT

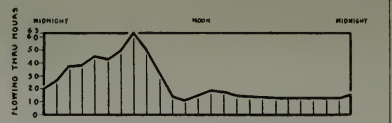


B CORRESPONDING VARIATIONS IN CONCENTRATION H_2S

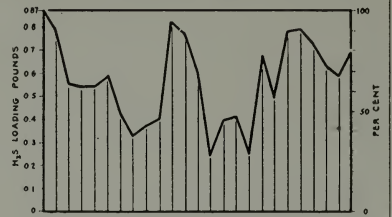


C. TYPICAL DAY H_2S LOADING EFFLUENT

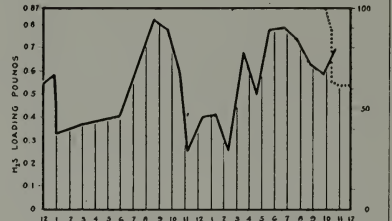
FIG 5



A. APPROXIMATION OF FLOWING THRU PERIOD ASSUMING FLOW LOADING CONSTANT FOR SEVERAL HOURS PRECEDING



B TYPICAL DAY H_2S LOADING EFFLUENT



C H_2S LOADING EFFLUENT RELATED TO TIME INCREMENT OF FLOW ENTERED PLANT

FIG 6

FLOW LOADING
INFLUENT
REMOVALS
EFFLUENT
SOLIDS DISCHARGED
LOADING P.P.M. SUSPENDED SOLIDS, INFLUENT & EFFLUENT
PER CENT REDUCTIONS
PER CENT REDUCTION
FIG. 6
P.P.M. SUSPENDED SOLIDS INFLUENT AND EFFLUENT OF PLAIN SUBSIDENCE TANK WITH CONSTANT FLOW LOADING
CHANGES OF SUSPENDED SOLIDS - P.P.M. IN RAW
PER CENT REDUCTION S.S.
FIG 8
A. TYPICAL DAY H_2S LOADING INFLUENT
B. H_2S LOADING EFFLUENT RELATED TO TIME INCREMENT OF FLOW ENTERED PLANT
C. CHANGE IN H_2S LOADING THRU PLANT
FIG 7

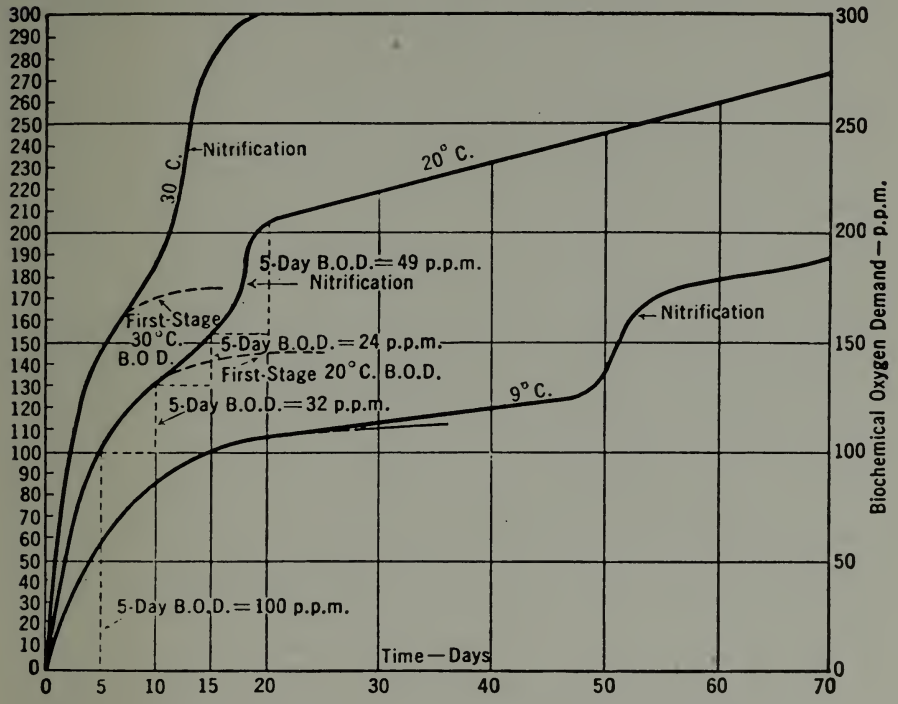


Fig. 10—Progressive Exertion of Biochemical Oxygen Demand at 9, 20 and 30° C. *After Theriault.*

BETTER METHODS FOR THE DETERMINATION OF GREASE

By HARVEY F. LUDWIG*

A discussion of the various proposed new procedures for the determination of grease in sewages and industrial wastes is very timely; these procedures are currently being carefully considered and tested by the Committee for Revision of Standard Methods. It is agreed that the old Standard Methods procedure has serious deficiencies and should be abandoned; but it is not agreed as to which of the new procedures should replace it. It is the purpose of this discussion to review and analyze very briefly the old Standard Methods procedure and also each of the proposed new methods, of which there are three. Two of these have been developed by members of the California Association.

The Standard Methods Procedure

The old Standard Methods procedure consists essentially of acidifying the sample, evaporating the sample to dryness, and extracting the grease from the dried residue by means of a Sohxlet. Several investigators have found that large errors may result from this procedure. These errors have been best expressed by Pomeroy and Wakeman (1) and may be classified as follows:

A. Errors arising from evaporating the acidified sample to dryness:
   1. Volatilization of grease
   2. Reversion of fatty acids to insoluble soaps
   3. Production of ether soluble matter (from combined fatty acid radicals without greasy characteristics, as egg yolk)
   4. Insolubilizing of oils by oxidation and polymerization

B. Miscellaneous errors:
   5. Extractions of non-grease materials
   6. Variation of results with various solvents
   7. Errors arising from drying the extracted grease preparatory to weighing

Obviously the most serious source of error is the operation of evaporating the sample to dryness, and the proposed new methods are all similar in that they eliminate this tedious and troublesome operation.

Determination of Grease by the Direct Wet Extraction Method

Pomeroy and Wakeman (1) have developed what might be termed a "direct" procedure, theoretically very simple, which may be outlined as follows: Acidify the sample; shake thoroughly with successive quantities of solvent until removal of grease is complete; transfer portions of solvent through a filter to a suitable receiving vessel; and evaporate the solvent, heating just sufficiently to insure complete removal of solvent. An additional operation, that of refluxing, is

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required whenever samples form stubborn emulsions with solvent; i.e., the solvent does not separate readily after shaking.

This procedure was brought to the attention of the writer in 1940 by Mr. A. M. Rawn, and was tried out on various sewages and industrial wastes in connection with the work of the East Bay Cities Sewage Disposal Survey. It was felt, however, that the method demanded considerable technique; so that more attention was directed towards the development of another procedure, which will now be described.

Determination of Grease by the Filtration Method With Preliminary Boiling and Freezing

This method has been described by the writer (3) and by Okun, Hurwitz and Mohlman (2), and consists of the following operations: Acidify the sample and boil for 10-15 minutes or until the grease has collected in a surface film; place beaker in refrigerator for several hours (overnight), allowing grease to freeze or congeal; filter (using aids to promote rapid filtration); return filter paper to beaker and dry in the drying oven; and extract the grease from the warm residue either by direct extraction or by means of a Sohxlet.

This method has been adapted for procedure by soap chemists for the determination of fatty acids in dilute soap suspensions. The operation of boiling insures complete reversion of insoluble calcium and magnesium soaps to the soluble fatty acid forms, and also collects the grease in a surface layer. The operation of cooling causes the collected grease to solidify, so that it may subsequently be separated from the liquid by filtration.

The method has been tested on synthetic samples made by adding various fatty acids and large amounts of $CaCl_2$ to sewages of very low grease content. Recoveries, made without Sohxlet, were practically complete.

Determination of Grease by the Filtration Method With Preliminary Chemical Flocculation

This is the method recently proposed by Gehm (4) and also investigated by Okun, Hurwitz, and Mohlman (2). As described by Ghem the procedure consists of flocculating the sample by adding an arbitrary amount of alum and by stirring; filtering (with aids to promote filtration); placing the filter mat with retained solids in a dish, acidifying, drying, and extracting the grease from the residue with a Sohxlet.

The writer has had no experience with this procedure, but two deficiencies or sources of difficulty seem probable. First, it is the writer's experience (5) that a satisfactory floc cannot always be obtained with sewage samples by the use of an arbitrary dosage of alum, especially in the presence of certain industrial wastes. Also, the fatty acids formed by acidifying the calcium and magnesium soaps retained in the filter mat may revert to the insoluble form during the subsequent drying operation; i.e., the calcium and magnesium

are retained with the grease on the filter mat. The error arising from this source may be very large (1, 3).

Discussion

Okun, Hurwitz, and Mohlman (2) have investigated all three of the new methods, using essentially the procedures just outlined; and their tentative conclusion recommends the use of the Filtration Procedure With Preliminary Boiling and Freezing, the final extraction being made with the Sohxlet apparatus. Their data indicates that this procedure gives results for sewage which are practically identical with those obtained by the direct wet-extraction procedure (without refluxing), and results for preliminary solids which are much larger than those obtained by the direct procedure (without refluxing).

A major difficulty in formulating a satisfactory grease test arises from the lack of an exact definition of just what the test is supposed to recover. Presumably it is desired to recover all "greasy" materials; so that certain mineral oils must be included along with the soaps and food grease derivatives usually found in domestic sewages. A satisfactory grease test should recover all these components, but should not recover any inorganic non-greasy salts present which happen to be soluble in the extracting agent being used. It is believed that in the filtration procedure with preliminary boiling and freezing all grease materials of sanitary significance will generally have properties such that they will be retained by the filter paper and will therefore be recovered, and that other materials of non-greasy properties but soluble in the extracting agent will generally have properties such that they will pass through the filter paper and will therefore not be recovered.

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DESIGN OF SEWAGE DISPOSAL PLANT FROM THE STANDPOINT OF DEFENSE RATINGS AND MATERIALS

By F. C. ROBERTS JR.*

In attempting to cover the subject as assigned, there are many items about which there is a great deal of doubt. The question of materials is one of paramount importance in the design of any plant. It is not the intention of the writer to present himself as an authority on the question of materials. At the present time there does not seem to be any agency to which we may refer, that has the final data on the availability of materials.

To illustrate this, we refer to the general letter from the office of the Quartermaster General, dated August 29th, in which zinc galvanizing is definitely on the "do not buy" list. From the contractor on the construction of the Camp Cooke water and sewage treatment plants, it is learned that it is far easier to buy galvanized metals than copper. Copper is hard to get, although not impossible. In the construction of the expansion joints on "water walls," it was possible for the contractor to procure an adequate supply of copper strips. However, it required a great deal of "shopping" in order to get quick deliveries.

The major building materials to be avoided in the design of a plant are those incorporating Aluminum, Nickel, Chromium, Copper, Cadmium, Zinc, and Cork. It is anticipated that this list will be added to in the near future. From this you may see, that there is a great amount of restrictions on the materials that we may employ.

Aluminum paint is out, as is all structural aluminum. Copper is suggested as a substitute for aluminum which would indicate that it is the more plentiful material.

The suggested substitutes for these materials or essential elements are those that incorporate asphaltum products, iron (with a definite limitation on its alloys), wood, and most of the plastics. This is according to the federal instructions that have been received to date.

The fundamental components of a sewage disposal plant, cement, aggregates, iron, wood, clay products, are still available; or at least have not been incorporated into the "do not buy" lists.

It is one thing to say you can buy these materials and it is quite another to get them on the job. Commodities like the aggregate in concrete will cause a great deal of delay in construction, if immediate delivery is required. A delay of some five weeks has been experienced in receiving enough steel and aggragate to cast the first quantity of concrete on the Camp Cooke water and sewage treatment plants.

With this shortage of materials, it is to be expected that prices will correspond. We all know that prices have gone up, but the exact extent is hard to realize. A low grade of lumber sold for $26 per

*Sanitary Engineer, Leeds, Hill, Barnard and Jewett, Consulting Engineers

hundred board feet one and a half years ago, $36 per hundred six months ago, and it is now $47 per hundred. This is an increase of 1.8 times in 18 months. Other commodities have increased in like measure.

Labor has increased in a somewhat similar scale. We think of labor costs as having mounted to heretofore unknown heights but these labor costs have not increased as much as material costs. Comparison can be made in labor costs by comparing a rate of 60 to 65 cents one and a half years ago, with 75 cents today. Skilled labor that cost $1.00 one and a half years ago is now in the neighborhood of $1.25 to $1.50 depending on the locality. However there are other limitations on labor that we must face. There is a premium of time and a half for Saturday work, and double time on Sundays.

This indicates that the work should not be specified to be completed in a short construction period, but extended over long periods. With national defense projects, it is vital that a short construction period be provided. With such short construction periods labor costs will increase in the amount of 21% for Saturday and Sunday work, let alone overtime on other work days.

Priorities

The major "bottle-neck" in sewage plant construction is the availability of materials. We have to face the priorities list today, which we did not encounter a few months ago. Do not be mislead by a priority number.

It is learned that the American Water Works Association has procured a priorities number of "A-10" for the water works industry. This would appear to be a good priority number, one that we might depend upon for materials. However, we find on the Camp Cooke project, that a priority number of "A-1-J" is a very poor one. With the navy and some aircraft plants holding priority numbers of "A-1-A," we may have our orders "shelved" until the priority numbers above ours have been filled. The city of San Diego has a priority number of "A-1-E" in the construction of its sewage disposal plant. It is probable that the navy considered the installation of this plant of sufficient public health importance to assist in the advancement to this high number.

On one of the projects engineered by Leeds, Hill, Barnard and Jewett, the priority number of "A-1-J" had to be advanced to "A-1-B" before an adequate quantity of pipe could be delivered to the job. This latter number was sufficiently high to permit ready delivery of material.

It should be appreciated that there can be 26 higher classifications than "A-2," such as "A-1-A" through to "A-1-Z." This does not indicate the possibilities of placing such classifications as "A-A-1," which would have a higher rating than "A-1-A."

The only item that you must bear in mind on the priority business is that you may get your order in and have it accepted with the promise of an early delivery, but if it does not leave the plant

before a higher priority order arrives the material will not be delivered until the higher priority has been satisfied.

Construction at this Time

With this type of situation facing the community desiring new sewage disposal plant, what is the answer? Should this community go ahead and construct a plant in these times, or should it wait for a return to lower prices?

In the opinion of this writer, there will be no return to lower prices. This seems a startling statement. Not one to be lightly considered. We must take the following facts into account:

1. Our national debt has approached such high proportions that we no longer pay much attention to it.
2. Under economic conditions that we faced in the early thirties, with a national income somewhere around 100 billion per year, we could support a national debt of 70 billion, according to advices that we received then.
3. In our present crisis, with our vast national expenditures, how are we to finance our debts?

To offer some solution to this problem we must recall the increase in materials price and labor costs mentioned in the first portion of this paper. If we do not repudiate our debts, the only way that we can handle a 200 billion national debt, is to increase our national income or devaluate our debt. This can be done with a controlled inflation. It would appear that we are going through this at the present time. Where it will end, cannot be forecast, but in the opinion of this writer it will not end until we reach a point that the national income, by our devaluated dollar, will be two to five times greater than our national debt.

A disposal plant built today will increase in value in five years a number of times, despite the high costs and difficulty of procuring materials. This is only the opinion of this writer, and should be referred to more competent economic authority for a more accurate forecast.

Cost of Disposal Plants

To those communities in defense areas, this subject of plant costs is of little concern. Many of these plants are financed by a 90 to 95% federal grant. These communities are indeed fortunate.

When we state that a plant will cost $4.00 to $15.00 per capita, we must consider our price structure. The price of these plants today, is not to be compared with the prices of yesterday.

In considering the cost of the Camp Cooke sewage treatment plant, it was estimated that this plant would cost $220,794 for a design population of 25,000. This would be a per capita cost of $6.30. In place of this the plant will cost $402,000 or a per capita cost of $11.50. This was not due to poor estimating, for one of the best estimators on the Pacific Coast was employed for this purpose. In the total gross estimate on the $17,000,000 cantonment, the bid price and estimate price varied by only $50,000, which furnishes us with an

idea of the accuracy of the total estimate. Individual items would vary according to the sub-contractors assuming the various portions of the work.

The sewage treatment plant contractor took into account the scarcity of materials, particularly the mechanical equipment, the short construction period permitted, the rising labor costs, and the difficulty of procuring certain essential materials. It is felt that the bid price on this unit was a fair one, and probably cannot be duplicated at the end of the next four to six months.

Designing on Defense Projects

There is little difference between the design on a defense project to the design of a municipal system except for two notable differences:

1. Time is of the utmost importance on defense project design.
2. There are a large number of persons that must be satisfied with the design.

In the past it required from one to two months to properly think through and plant a sewage plant, if an involved plant was to be constructed. With national defense projects this time interval must be reduced to one half or one quarter if possible. This leads to errors which must be eliminated by the "check and double check" method, even up to the moment that the structure is undergoing construction.

A plan may be effected but vetoed by higher authority. The opinions of higher authorities do not always agree. Federal personnel and their consultants, and state personnel are all in positions where they may provide valuable recommendations. In case of any divergence of opinion the designer is in the embarrassing position of attempting to satisfy one and deny the other.

Under municipal practice, the parties to be satisfied are the state department of health and the local community for whom the work is being performed.

As is the practice with army procedure, most activities are governed by rules and regulations. The design of sewage disposal plants is no exception. A "bible" has been prepared giving most of the basic data upon which a sewage plant is to be designed. The original basic data was compiled by the firms of Metcalf and Eddy, and Greeley and Hanson.

From a casual perusal of this publication it would appear that everything has been answered, but this is not the case. The designer may use this as a spring-board for the start, but the "big swim" shortly follows.

The army standards as prepared by the Quartermaster General emphasize a number of items such as:

1. Longer detention periods in clarifiers.
2. High peaks in daily flow.
3. High strength of army cantonment sewage.
4. Use of High rate filters.
5. Low recirculation ratio of these filters.

6. Use of chlorination to "take up the slack" in sewage treatment practice.

The Metcalf and Eddy, Greeley and Hanson report states: "Plain sedimentation, or plain sedimentation followed by trickling filters, and in particular high-rate trickling filters, with provision for ample chlorination, are best suited to the emergency program." From this statement derives most of the impetus on the high-rate trickling filter construction for cantonments. It is felt that high-rate trickling filters provide a long felt need in sewage treatment practice. However, it must not be overlooked that this method of treatment is not the panacea for all treatment problems.

To meet the conditions imposed on most treatment plants, flexibility is of considerable importance. A difficulty encountered in sewage plant operation is that at the dedication of a plant a valve is opened and the plant proceeds to operate on a set "flow sheet" until it is obsolescent. The operator is in the position that he must take what is offered. It is similar to buying a car without a gear reduction mechanism. We have built flexibility into our automobiles to meet varying loads, the same should be done with our sewage plant designs.

With regard to the army standards, the emphasis on longer sedimentation periods is a safe one. From the literature it is learned that it was two decades ago that septic tanks for municipalities were designed on the basis of 8 to 12 hours detention. This was lengthened to 24 hours for small units, where septic tank use was most applicable. We now find the trend toward longer sedimentation periods in our clarifiers, with greater dependence on the settling properties of the sewage. The army report suggests 3.0 hours ahead of trickling filters to 1½ hours ahead of activated sludge. Secondary tanks are to be designed for 2¼ hours, whereas secondary tanks following high-rate filters have detention periods of twice this amount.

The army report has provided a sliding scale for the design sewage flow peaks according to population. The design ratio of peak to average is 5:1 for 1,000 population and 2.28:1 for 50,000 population. By the design for peak flows a safeguard is provided in the face of the 70 gallons of sewage per capita per day that is assumed. From a number of sources it is learned that in many camps the per capita flow amounts to approximately 100 gallons per days.

The report presents as standard cantonment conditions a sewage of comparatively high strength, with 269 p.p.m. of B.O.D. and 460 p.p.m. of suspended solids. This should be compared with figures that have resulted from actual operation. These figures have not been made available to the writer.

The army standards advise low recirculation ratios for high-rate filters, with chlorination to take up the "slack." In municipal practice much higher ratios should be used, except in those instances where the population will increase in proportion to the development of the defense area, and then decrease with the completion of these

activities. The recommended army dilution ratio is 1 to 1, as compared to a recommended municipal ratio of 1 to 2½ or better 1 to 5.

Camp Cooke Project

Before closing some outline should be presented on the Camp Cooke sewage treatment plant. This has been known until recently as the Santa Maria-Lompoc project, inasmuch as it is located between these two California towns. The plant is a two stage bio-filter plant, designed according to army standards, with a maximum of flexibility provided. After plant treatment, which includes chlorination and chlorine contact, the plant effluent is discharged onto 67 acres of oxidation beds. From this point the flow is to be discharged into the Santa Ynez River. This sewage has an unusual purpose. It is to be used to raise stream flow to the point that a constant flow or impoundment of water will occur behind the Salt Water Barrier. The purpose of the barrier is to force surface flow into the underground strata, raising the water table, causing fresh water to force salt water out to sea. With this in view the sewage must be adequately treated. The combination of plant and oxidation beds should accomplish this purpose effectively.

The heavy pumping on the underground water of the Santa Ynez River caused by the army wells might ordinarily cause a salt water infiltration. This process is to prevent this condition. The effectiveness of this process will be of considerable interest to most of the cities of the coastal plain. A further report on this might be of interest after a period of one or two years of operation.

OPERATORS' SYMPOSIUM

October 12, 1941.

MR. GRAY: Gentlemen, with your kind permission, we will call the annual convention to order. This afternoon we are to have a symposium on various operating problems, more or less on an impromptu nature. Some of the boys have been primed, but general discussion by all is in order. I am going to turn it over to Whalen Jones, vice-chairman of this committee.

MR. JONES. Fellow operators, I will have to carry on the work here in the absence of chairman, Ralph Sotter. We will start with the subject of "Plant Records" and I shall ask Mr. Allen to lead off.

Plant Records

MR. ALLEN (Pasadena): This subject of plant records has been discussed previously, and I do not know that there is a great deal that can be said, except to stress the fact that plant records are of considerable value, more to check your past experience when you get in trouble. We know from our own experience that by checking back on our records when a particular difficulty develops that we can sometimes find the answer—not always, because the conditions are not always the same. But we have found them more or less invaluable from that standpoint.

We keep fairly complete records for that very reason. We have found that records are of particular value when we have sludge bulking. We incline to the school of belief that when we get sludge bulking the best thing to do is get rid of it and start over again. We have found that works pretty well.

We have another problem, that of seasonal flows. It is quite a help to have complete records so that you can go back and check the pumping rates of various flows, particularly on low flows; and it saves you fooling around and guessing.

If you go into the question of new additions to be built and you employ a private consulting engineer, your records save you a lot of headaches. We have found that from that standpoint records are worth their cost of keeping.

They also give you a good basis of comparison or yardstick in effecting economies in plant operation. We use them for that about as much as anything. We can go back and compare month-to-month records for various years, and if something is costing more than it did the year before, we can find out why and correct it.

MR. KIMBALL (Santa Ana) Mr. Allen, after you have all this information, how do you review it at the end of the year? Do you make out charts, graphs, or anything like that?

MR. ALLEN: We make a monthly report of the chemical analyses and also of our flow records and various other items. We keep that report. At the end of the year we make a recap of it for annual

report, giving the averages for the year and also the monthly averages.

MR. GRAY (Berkeley): Mr. Allen, I notice in your annual report you had a very elaborate cost analysis of operation, but there was absolutely nothing in there that would give anybody any idea of the capital cost, that is, your interest charges on the investment, bonds, and so on, and things of that kind. Why do you leave that out? Is that done with a purpose, or don't you feel it is part of the cost?

MR. ALLEN: It is a part of the costs definitely. The reason it is left out is that it has only been in recent years that we have been keeping fairly accurate cost records. In the early days the records were kept by the department in the City Hall, and the only figures we show on capital is the total historical cost. We show no breakdown. Our report is primarily an operations report, and not a financial report. And it is long enough. If we make it too long, no one will read it. If we put all of that in there, it is more or less superfluous from the board of managers' standpoint because they get the controller's report, which contains all the financial information.

MR. GRAY: But you have that for your own information available to you?

MR. ALLEN: No, I don't have it at the plant; they have it at the City Hall. That is the reason it does not appear in my report. I do not keep a record of that. It is definitely a part of the cost, though; there is no question about that. There is a figure of the total historical cost and the capital outlays for the year.

MR. JONES (Stockton): I shall continue the discussion on plant records.

In 1939 I went over to the South Disposal Plant, and found the records told little, if anything. There is quite a bit of poetry in and through them, but little record. So, we designed a daily sheet and a monthly sheet. We find that if you have a regular time to add your sheets in the morning and take care of your previous day's report, it is a simple matter. So, we made it a practice at a certain time to take care of the records for the previous day.

We have a daily sheet I designed. The first thing is to start out with a piece of paper with some lines on it, and then keep adding until you get the sheet as near as you can, and then have some of them printed. We take a daily sheet, then we take our readings, both of our pumps and of our kilowatts, and the temperatures and the rainfall, and I think pretty nearly everything that we could. It requires very little attention, as I said, if you do it every day. We make a copy, one for the City Hall, and a copy for our plant.

Then in the office I put up just a rough sheet, on a piece of plyboard, hung up in the office. And each day I plot the flow. It is simple and requires very little attention. And we find that those visiting the plant are much interested in it. The total flow is shown at the end of the month. It is quite interesting, especially when you get to the cannery flows. We have a rather uniform flow through

the rest of the month; but when we get near the cannery, we have that sudden rise.

A GENTLEMAN: Do you have a heavy flow in the winter-time—in the rainy season?

MR. JONES. Yes, we have for short periods. Very little storm water comes into the sewers, mostly all sanitary waste. We have a peak only for a short time, an hour or two after a heavy storm.

Then from the monthly sheets at the end of the year I make up an annual report. I have the highlights of the month on a monthly report. In fact, it is a monthly report by the year.

Then on the back of that we keep the total cost of the number of cubic feet of screenings and the cost per million gallons for power and for handling, and things of that nature; the average daily flow and the total sewage in million gallons and cubic feet of screenings; taxes and telephone; and the breakdown of the entire cost in the plant for the year. This was kept for '38, '39 and '40 on the same sheet.

We have an adding machine. It cost two and half. A very simple little arrangement, and you can add up your sheets in very short order with it.

I know that we are planning some improvements in the plant, and my records have been pawed over a great deal the last few months at the City Hall. It makes the operator happy when he can answer the questions they want to know.

A GENTLEMAN: Mr. Jones, on this maintenance of your plant, do you carry that through your operating—the million gallons on your cost per month, or do you carry that in on the maintenance sheet?

MR. JONES: No, that goes right in.

THE GENTLEMAN: On your operating cost?

MR. JONES: That is right. The only thing we do not separate is our lighting over our power, because we have a transformer to take the power from four-forty to a hundred and ten; so it comes under the same. We are proud that each six months our cost has dropped.

MR. ALLEN: Mr. Chairman, I would like to make the same offer I made two or three years ago. I will be glad to exchange the annual reports with any operator who wants to trade reports. I would like to get some of the other fellows' reports if they make one, and I will be glad to send them a copy of mine if we can make a trade. We do not send them out to everyone, but I would like to trade with some of the fellows if they like. I might learn something from them, and they may get something from ours.

We do much the same as Mr. Jones does, except in our lab we keep a record for a year on the board for the chemical results, and some of the other various figures. So, we have a whole year for comparison at a glance. We have found that quite a help.

MR. JONES: I will do the same as Mr. Allen. Any one desiring

a copy of the sheets, I will be glad to send them to him without obligation.

MR. ALLEN: My main reason for making this offer is that I think if we can get these reports made up and a circulation of them, it will improve all of our records. I think every plant should have a complete set of records. If the fellows will put a little thought in and make up an annual report or monthly reports and trade with the other fellows, I think it will improve everybody's records.

Disposal of Screenings

MR. JONES. Mr. Gwin of Folsom is the next on for "Methods Used in Disposing of Rags and Screenings."

MR. GWIN (Folsom Prison): On the disposal of rags and screenings, it largely depends on the amount you have and the location of your plant. I believe I could get any man that operates a plant to agree with me that it is necessary to dispose of rags and screenings as quickly as possible for the reason that they have much matter that decomposes rapidly and that causes odor around the plant. Now, at Folsom Prison we have solved this problem. Our screens are raked manually. A man rakes his screens, and in turn he puts them in a cider press. From there they go to an incinerator. I would say that our screenings do not stay in our plant longer than an hour at any time.

At one time that was quite a problem with us. When our plant was first built they had cement boxes for our screenings and for that reason we tried to use them but we found that we were using about two hundred pounds of chloride of lime a month to dispose of this odor and still flies were after us all the time.

Now we have a problem at Folsom Prison that many plant operators do not have. Our inmates there order about two thousand sacks of tobacco per month, besides the other things they buy through the commissary, and, of course, we get a lot of those things. The men are put in their cells at about four o'clork in the afternoon and they stay until about seven-thirty in the morning. So, any of their waste naturally goes through the toilet. Our biggest item — the one that caused us the most trouble in the beginning—was this cellophane paper. That made a nice dam around the screens, and the water couldn't break through. So, we decided to build this cider press to get the water out of the rags, and then haul them away. But that cost money for trucks. We had to build this incinerator and burn them. We use the gas that is at the plant for the fuel, and in that way have plenty of fuel at all times.

I charged the sewage plant up fifteen dollars for the entire output, which was made out of just waste material. These plants that do not have natural gas, that is, sewage gas, would have to find some other fuel.

MR. SCHUCK (Burlingame): We dispose of our screenings in about the same way. We have a buggy that catches the screenings, and the water drains back into the pit, and they are taken out and

burned in a gas burner that we made out of a square of brick with a grate.

MR. THEWS (Terminal Island): We have a hand-raked bar screen that we rake hourly, or oftener if need be. The trouble now is that we have a flow of approximately three and a half million gallons a day, and the bar screen in the central passage has a three-quarter inch clearance between the bars, with a by-pass on either side of that about an inch and a half clearance. The rags are raked from the bar screen, placed on a drainage bridge and allowed to stand there for approximately an hour. When the man comes back to rake the bar screen the next hour, the rags that he had raked in the previous hour are dried. He pushes them down the chute into a wheelbarrow.

At the end of the shift the rags are burned in the incinerator with sludge gas for fuel. We dispose of the ashes from our incinerator by filling in the low spots we have around there.

In eight hours' time we usually get about three cubic feet of rags and screenings, in other words, about three cubic feet to three and a half million gallons of sewage. In hot weather sometimes that is not quite so good, because your rags are standing out there for at least eight hours and attract flies. We arranged a cover to put over the top because the rags would attract seagulls.

MR. STRANGARD (Alameda): I think the answer to this question is a macerator. In my plant, the sailors there throw their shorts —they call them "skivvies"—when they get soiled into the toilet, and they go through the maceraters, are completely chopped up, and we have no trouble about rags.

MR. ALLEN: We have comminuters, too, but we put a screen after them so that we can catch the rags that are chopped up. Terminal Island is fortunate to have digesters; we do not. After the rags are chopped up and get into your plant they will work together again and give plenty of trouble.

MR. BENAS (San Francisco): In San Francisco we do two things that I suppose might enter into the picture here. One is to take the screenings and grind them in a shredder, and that takes care of practically all the material, with the exception of some metal bars and some stones. Those are segregated. We found when we originally operated the shredder that we had considerable trouble with odors during the grinding process, and we found that adding a solution of boiling water to the shreddings before grinding stopped that odor.

We have had considerable maintenance on the teeth. It seems they have to be replaced about every six to eight months, and during that time they require three or four sharpenings. Now we can cut down on that replacement by taking the screenings from the sewer before they come to the shredder and by disposing of them in the separate incinerator, operated on a by-pass off the gas line going to the boilers, which has about five hundred cubic feet an hour capacity of gas. So far, we have been able to dispose of all those screenings.

MR. ALLEN: Did you cut down the maintenance on your teeth by taking out screenings ahead of the comminutors?

MR. BENAS. We have no comminutors but some of the screenings that came into the Sunset Sump affected the life of the teeth. So, by taking the screenings from these sources and sending those into the incinerator, we have only the rags, and the other is handled by the shredder, which makes the life of the shredder longer than it would have been otherwise.

There is one other point, too, when the screenings come off the mechanically cleaned bar rack, they are not balled up as much and the shredder handles the ball material. Those materials which did cause us trouble in the shredder we now handle in the incinerator.

MR. GILKEY (Roseville): We are fortunate in having a pump that pumps almost all of those rags up into the digester. What are too big or what we happen to catch, we just throw out. They do not cause much odor, unless they stay there three or four days. In the summer time especially we burn them every day, less than a cubic foot in a week. That, of course, has a tendency to build up a sludge cake on top of the digester, but it is not serious enough to make any difference.

This summer I took off about three cubic yards of float on top of that digester, consisting of rubber and sticks and blocks of wood and all kinds of rags, although those rags will digest if they go down and have the proper time. So, it takes about forty-eight hours for that skimming off of the top of the digester to dry, so that we can burn it. The only odor we get is when we do burn it, and that is just like any rubber or rags or anything else you burn.

MR. JONES: Do you use gas to burn the incinerator?

MR. GILKEY: No, we have no gas.

MR. POST (Lodi): At the Lodi plant, we have a bar screen with openings about one and one-half inch. We have disposed of the screenings by burying in the past, later on we used drying beds and then they were dried to a reasonable point to handle and people came and hauled them away. Later a rancher has built a trailer car that will hold possibly 48 cubic feet of the screenings and comes once a a week to collect. We put an extension on our elevator so that it will discharge into his car.

MR. JONES: In Stockton we have a grinder and the rag situation is serious. We require about every six months a new set of teeth. We find especially during the cannery season that we get a lot of stems and things of that nature that give us a great deal of trouble. They will pack in the bars, and the grinder has to be cleaned each day manually. It seems as though this grinder just grinds them up in long strings and then they drop down into the bottom of the sump, and the pump picks them up as a ball. The first thing you know, you are cleaning your pump out with a ball that looks like waste. So rags are a very serious problem around our plant, especially when you get as many as we had, for instance, last month, four hundred and

two cubic feet, thirty-five cubic feet in one day. Our plant has the State Hospital on it, and they have rags all the time, because the inmates put down sheets and pillow cases and dresses and things of that nature.

We are going to build an incinerator like Mr. Gwin has at Folsom this next year for burning the rags, with a little press.

MR. ALLEN: We have a three-quarter inch opening between bar screens, and we bring the screenings up onto a conveyor and discard them into a truck. The driver of the truck slopes it so that the screenings drain. We empty the truck once a day and cover it with sand, and do not have any difficulty with screenings at all that way. We get about two and a half or three cubic feet of screenings, mostly rags, to a million gallons of sewage. And since we have eliminated the fine screens, we have decreased the amount of screenings about 80%. When we used to have the fine screens we got five or six truckloads a day; now we get about one.

We have a bar screen ahead of the comminutors, and have only replaced the teeth on them once in five years. I think that is probably due to the fact that we have the screen ahead of the comminuters. We have one following that gets out about a cement bucket full of just plain rags and papers a day. Those are all taken to the sump together with the skimmings and taken to the wash and buried. Until the problem gets more troublesome, we will probably continue to do that. It is hardly worth while to build an incinerator but we might do that. We have found that if these screenings containing certain fecal matter are allowed to lay undisturbed on top of the ground they do not give off any odor and will attract very few flies. But if you disturb them, they get odorous, and we cover them over each day as we bury them.

MR. VAN NORMAN (Los Angeles): Of course, burying is one way of getting rid of them if you have room. Our screenings are about thirty-five tons a day. At the present time Kellogg of Garden Grove is taking them and using them as an ad-mix with adjusted sludge for fertilizer.

We still burn the rags. For these we have the advantage of an incinerator. It takes, I would say, around twenty to twenty-five gallons per ton of 85% moisture. I think that is quite economical. We have never been able to successfully burn rags in any homemade furnace. If you can burn them, I believe it is the best method of disposing of them.

MR. ALLEN. Are your screenings stored before Kellogg takes them away?

MR. VAN NORMAN: We had to add several large tanks. They hold, I think, twelve hundred cubic feet. We can take almost a day's run in two tanks, and we keep one under pressure all the time and lift them into a de-watering press. After that they are put through a rotary drier.

MR. ALLEN: You actually dry them before Kellogg gets them?

MR. VAN NORMAN. Yes; I think it gets down somewhere between 45 or 50% moisture content.

MR. ALLEN: I mean, you process them before delivering them to him, though?

MR. VAN NORMAN: Yes, we reduce them down to probably 70% moisture content; by the time we further reduce the moisture content by this rotary drier.

A GENTLEMAN: Will you tell us how little luck you had on trying to grind rags?

MR. VAN NORMAN: We had a grinder and the promise was great. After a thorough try, it proved absolutely worthless. That is rather a strong expression, but in the case of rags it was of no value. Under any normal load it just bogged down, and we could not use it. We could put rags in there and grind steady for fifteen or twenty minutes with no results. So, if any of you fellows have in mind a grinder, you had better take care, because we have not found one that was successful to grind rags. We were intending to put them back and dispose of them along with the rest of the screenings, but we still separate them and burn them.

MR. ALLEN: Is there any objection to putting them right in with your screenings, the way you are doing now?

MR. VAN NORMAN. Yes. Our bar screen openings originally were about two and a half inches. We have reduced that to a space of three-quarters, for the reason that whenever you try to operate any machinery, moving shafts, gears, or any other thing that rags come in contact with, they wrap around the shaft and around the gear. They even throw the elevator chains off in the pits by getting around the tail pulley at the bottom or around the top of the gear in the elevator itself. If you can keep them out where nothing mechanical is moving, you are going to be better off.

MR. ALLEN: I meant perhaps if you added them to your drier.

MR. VAN NORMAN: Well, I do not think that they would be very good as a fertilizer.

MR. ALLEN: Oh, no, they are of no value. I mean, in the disposal of them.

MR. VAN NORMAN: Well, you mean, to force the contractor to take them along with the rest?

MR. ALLEN: Yes.

MR. VAN NORMAN: Well, we never have forced that; but just agreed not to do it.

MR. JONES: The only thing that I might say on the Stockton plant is that the screenings were twenty-two cubic feet per million gallon last year, and about twenty-five cubic feet this year.

Disposal of Sludge

MR. JONES: Our dried sludge is quite a problem at Stockton. The tomato canneries have ruined our sale of sludge, because of the skins and seeds.

MR. FRASCHINA (San Francisco). At the Richmond plant, the sludge is used for fertilization in Golden Gate Park, and the park has been taking the sludge now for about two years, since the plant has been in operation; and they want more than we can produce.

Our sludge happens to have a pretty high nitrogen content, about three and a half or four per cent; high for a digested sludge. It is hard to explain why that should be, except that our raw sludge has a volatile content of about 85% per cent. Our guess is that it is probably due to the good diet of the people tributary to the plant. The whole area is strictly residential; there is no production waste of any kind coming in, and very little ground water.

Incidentally, the phosphorous content is two and a half hundredths of a per cent, but that is quite a bit higher than you would normally expect to get. It has been used in the park, and worked very nicely, particularly on grass. They have made some comparative tests where they have used the sludge as compared with cow manure, and it produces a beautiful green grass. It has a very strong body and color to it, and grows about four times as fast as any of the other grasses. There does not seem to be any difficulty in applying. It is applied direct to the top of the ground in a layer an inch thick, and in some cases it is allowed to dry and in other cases it is watered immediately, but it does not seem to make much difference. There is no burning of any kind and no weed seeds, and it seems to inhibit the growth of wild weeds in the grass itself. Of course there are a few tomato seeds. In fact, the few plants that do come up are killed when they are cut with the lawnmower.

We are now proposing a series of tests to actually find out how to use the sludge most productively. Each gardener in the park has used it as he saw fit; so we are trying to work out a program to standardize the use. We propose to try different amounts under controlled conditions with different methods of watering.

The sludge has also been used on shrubs and flowers. On shrubs it has worked nicely. There is one hedge that is about forty years old, and Mr. McLaren, the Superintendent of the Park, said that the shrub was going to die. We spread a little on the top of the ground around the roots, and the thing came back beautifully. That seems to be the experience with almost every use of it. Similarly with rhododendrons. There are several collections in which they were dying, and a little sludge spread around made them come to life.

The only instance where there has been any question is in the use of it with flowers. When they have used it as a mulch or top dressing, it has worked effectively; but there have been several instances where they have dug it into the ground. There have been several cases where the growth is not as good as anticipated. We are going to find out with this series of tests. We will plant flowers under controlled conditions.

One particular field that had a lot of sludge put on it had not been watered for about two weeks. Usually under those circumstances the

grass gets yellow, and may even die. After watering the grass came out beautifully in one day.

One thing that seems to apply to the use of all fertilizer, is that you have to use a lot of water with it.

Another thing it seems to increase the water-holding ability of the soil, so that the total amount of water used is cut down. Estimates are that they use about a third to a half the amount of water that they needed before. That is important with the park because it has a large area.

MR. ALLEN: I wondered if San Francisco had ever considered the possibility of using the sludge in the liquid state, as they are doing in the East.

MR. FRASCHINA: Yes, we had thought of that.

MR. ALLEN: That would cut down your watering considerably and save the cost of de-watering.

MR. FRASCHINA: Yes. In this proposed series of tests on the grass we will also use the sludge in the liquid state, and compare the conditions.

MR. ALLEN: They seem to be having pretty good luck in the East.

MR. FRASCHINA: With sludge the gardeners have reported no burning of any kind and no deleterious effects. Only one objection that might be raised is that of odor. The only further question is that of handling the sludge. As handled now, it is shoveled by hand, and if they spread it as soon as it is received, it is far easier than if piled for any length of time.

MR. ALLEN: Can they use a mechanical spreader?

MR. FRASCHINA: Yes, but one of the difficulties is the lack of funds.

MR. ALLEN. Where is this? In San Francisco?

MR. FRASCHINA: On one particular field they used cow manure and on the other sludge. And there is a very sharp line of demarcation between the two. The grass with the cow manure is quite a bit yellower, and it did not grow with anywhere near the speed that the other did.

A GENTLEMAN: Did they use the same amount of nitrogen?

MR. FRASCHINA: It is hard to say just what the fertilizer content was, but as far as the park is concerned, it is an excellent source of fertilizer.

A GENTLEMAN: Does the general public know about it, and does the general public have any complaint?

MR. FRASCHINA: No, they do not. Their only complaint is that they cannot get it themselves.

A GENTLEMAN: Is there any danger in using it?

MR. FRASCHINA: They are using it only on flowers and trees and not with vegetables. So the danger would be quite small, I would say. In the first place, the period of digestion is approxi-

mately twenty days, and you get a great reduction of any pathogenic bacteria by that time. And, then, secondly, the washwater that we use for nutriation is carbonated water. We have never run any bacterial tests, but it would tend to be quite low.

A GENTLEMAN: I found one instance in Oregon where the use of sludge was about the best keep off the grass sign you could develop. We had areas in a city park that we spread the sludge on from time to time, particularly those that were tramped out during band concerts, and this would keep the people off the area without any difficulty.

MR. FRASCHINA. That does not seem to be the experience in San Francisco, but most of them do not know it is sludge.

A GENTLEMAN: Do you know whether there would be any danger of bacteria from people lying on the grass?

MR. FRASCHINA: Well, I don't know of any direct work having been done on that, but there has been plenty of evidence to show that there is the chance of the survival of dangerous bacteria in any sludge. It should be used with caution on that score. But on the other hand, the evidence seems to indicate that it is quite innocuous.

MR. REINKE (State Board of Health): All the evidence that we have had as far as dried digested sludge is concerned, shows little danger. Most of the bacteria that stand drying will not live in a digestion tank. There are possibly one or two exceptions to that. Maybe Mr. Gray knows about that. So far as I know, nothing has been done on amoebic dysentery. The greatest objection we find is psychological or asthetic. I am rather surprised that there has been so little objection in San Francisco.

MR. GRAY: I have a recollection of seeing some work where they had fairly well determined that the spores of the amoebic dysentery would pass through the digestion tanks, and there is a fair possibility that they may survive in an effective form.

I got some finely powdered sludge from the Dakota plant lately and put on my lawn. None of my neighbors stopped me and we hardly noticed it either. The lawn looks a lot greener.

MR. WALKER (Decoto): We have four sludge beds four feet deep. Last June the tomatoes started to come up by the thousands. There was a man farming there, and he disposed of about twenty-one thousand of them for a dollar and a half.

MR. JONES: The trouble we have in Stockton is that we have two kinds of tomatoes; one pear shape and the other is a beefsteak, and we can not tell which is which.

MR. GWIN: We have various ways of disposing of our sludge at Folsom. A rancher has about thirty-five acres of ground that he cultivates for his garden. At the present time we are furnishing about twenty per cent of his fertilizer. He also uses the fertilizer from the horse barn and the dairy. Our fertilizer does not seem to burn as badly as the fresh fertilizer.

I might say, in the winter time we have had a little difficulty,

along with the rest of our troubles. As Mr. Reinke might verify, the last time that I saw him we had sewage pumped all over our lawn. We have four drying beds, and of course in the winter time they do not dry so good. The second winter I got a tank that holds about eight hundred gallons, and we hauled it off.

MR. ALLEN: We make a really high-class fertilizer. We mechanically dry it, and we package it and sell it. It usually runs from six and a half to seven per cent nitrogen.

MR. REINKE. I would like to know your experience of odors at Stockton. It is of interest to me in defense of my nostrils and those of my neighbors. I might say that both the San Francisco sludge and the Dakota sludge that Mr. Gray mentioned I believe have some chloride added. And the material that I took home did not have chloride in it. I don't know whether that had anything to do with it, but whatever I had sure smelled. My neighbors wouldn't speak to me.

A GENTLEMAN: I was down in Imperial Valley for a while, and I got some well digested sludge and put on the garden right under the bedroom window in the hot summer time, and we couldn't even open the windows for a while.

MR. JONES: At Stockton we use the lagoons for digesting. And I do not find that the odor is any stronger than that from some of the other plants.

The park department uses it and are glad to get it. They use it on the lawns around the City Hall and in the parks in general. They seem to have better luck with it on the lawns than they do around the shrubs.

A GENTLEMAN: There is another angle to that lawn use. In the sunlight the grass, due to the chlorophyl, gives off a great deal of something. That is why they put their white sheets and towels on the grass to bleach. It may be the reason that there is actually less odor by spreading the sludge on lawns than spreading it around plants, where it is on bare ground.

Beautification of Plants and Grounds

MR. FACCINI (Stockton): Beautification of grounds is all right if you have the time to do it. A lawn is nice and beds of flowers, trees and geraniums are fine. In San Joaquin County, whatever one operator has growing on his lawn, he sends the seeds over to the next operator's plant.

We find that aluminum paint is about the best to hold up, with the different acids in the sewage. We find that arco paint is about the best paint we can use for our switches, motors, pumps and floors.

MR. JONES: That is one of the advantages of our San Joaquin Association. It is hard to get money out of the City Hall for plants and shrubs; so between the plants in our group we switch sweet pea seeds and crysanthemum plants back and forth and help one another. When it is time to dig up the canna lilies, we divide them among our fellow operators.

MR. HOSKINSON (Sacramento): Since disposal of sewage, though one of the most essential is probably the least attractive function of any political subdivision, it is important that this function be performed not only without offense to any citizen, but everything reasonably possible should be done to insure that this may be accomplished in the most attractive possible setting. This setting should properly be equal, if not superior, to that of other municipal or district functions so that the taxpayer, instead of being offended by the presence of the pumping plant or disposal works, may be proud of its presence in the community and of his part ownership in the plant.

The accomplishment of this ideal is not always easy and may be expensive, but not necessarily so. The need for entire elimination of plant odors must be accepted as a prerequisite; following this, interior finish of a plant need not be in shiny or dull blacks and depressing dark grays, even though some of the less prominent features may be so finished for greater durability of protection. In parts of the interior not subject to gas attack, bright colors such as might be used in most modern bathrooms and kitchens are available in enamels which will be found most durable for plant interiors. Painted floors in motor rooms particularly are desirable, even though more maintenance is necessary, as nothing gives an interior a fresher appearance than a newly painted floor.

For exteriors light colored walls of buildings, either white or in near white shades, are desirable to maintain the appearance of cleanliness. The plant should, if possible, be surrounded by an expanse of well kept and partially shaded lawn with appropriate trees and shrubs, of which many should be of the evergreen variety, surrounding the main buildings. It is not believed that planting should include too many flowers, as these sometimes require more maintenance than can be given by an operating crew along with their other duties. It is important that a plant should fit into and blend with its surroundings and, if possible by dignified and simple architecture, blend harmoniously with the neighborhood. We do not believe that the presence of disposal plant should be emphasized by flood lighting, except for protection. Rock gardens, simple pools or electric fountains are desirable features. To identify the plant as a public building an appropriate flag pole should be set firmly in the grounds and the flag of our country should be raised each day and lowered and carefully stored indoors at sunset. The flag should be replaced at proper intervals and never be allowed to become soiled or frayed by the wind.

In short, the plant should present a pleasing and dignified aspect so as to create in each citizen a pride of possession, as it has been found that citizens are much more likely to approve of bond issues for needed improvements if they have knowledge of the plants activities and needs through an appreciative understanding of its functions and first hand approval of its appearance as a public asset.

MR. STRANGARD (Alameda Naval Air Station): Since I am entirely unqualified for this subject, I prevailed upon Mr. Emery A.

LaVallee, who is landscape engineer of the Air Station, to give me a statement.

The U. S. Naval Air Station at Alameda ranks as the largest of its kind in the Western Hemisphere. The area embraced amounts to approximately 1000 acres of reclaimed land, built up over the tide lands of the San Francisco Bay.

Dredger fill of sand, silt and clay varying from one to twenty feet in depth, forms the foundation of the site. In the initial proceedings for a landscape scheme, soil analysis indicated a range of 500 to 40,000 parts of salt per million. Desired leaching was accomplished through rainfall of last winter. Subsequently anaysis showed a reduction of salinity to 100 parts and less per million.

Framework planting consisting primarily of indigenous trees and shrubs, foundation planting of building structures with occasional tree groupings to bring out a natural park like effect, street trees, flanking roadways, and appropriate planting and lawns for residential quarters is the keynote of the scheme.

The introduction of a ground cover over approximately 500 acres of lifeless sand and clay formation required such vegetation that could take root and spread over the surface of this inert mass with a minimum of attention within the shortest space of time.

Ice plant of the variety (corpobrotus edulis) commonly known as sea apple, was considered but found quite costly.

An unheralded product from Kenya, South Africa, known is Kikuyu grass (Pennisetum clandestinum) was offered for experimental purposes. Kikuyu grass is a perennial running grass and does not seed. It has branching leafy stems with flat and spreading leaves of a vivid green color. Kikuyu is only propagated from stolons taken from roots, runners and rhizomes.

Fertilization consisted of ammonium sulphate and bone meal during the spring period. As a protection against any undue erosion, a cover crop of Italian rye and vetch grass was introduced between Kikuyu and fertilizer installation served this function.

In the areas which depend upon rains for irrigation, it is estimated that a Kikuyu ground coverage requires approximately twelve months to complete the desired growth, while artificial irrigation will shorten the growing period by about six months. The complete grow of this grass will produce a root matting of from 4 to 5 inches in depth.

Kikuyu is primarily a summer grass and will remain green until a severe frost attacks it. If used as a lawn, irrigation and mowing should be resorted to at least every two weeks during the summer season.

It is estimated that the cost of installing Kikuyu grass over the Naval Air Station at Alameda will be between 10 and 15 per cent of the cost of any other form of rooted cuttings.

MR. SHEARER (San Anselmo): There is a little further point on the subject brought out by Mr. Hoskinson, particularly relating to the effect on the public and possible bond issues. Some day you will probably want to float a bond issue, and it is nice to have the

public think well of you and know that your plant and all your department is doing all it can to give them what they expect.

Now, some of the communities, besides just operating a sewage-disposal plant, also are tied in pretty closely with the maintenance of their sewer system throughout the town or district. Keeping your rolling stock and your men and everything that is on the road as neat and in order as you do your plant is of equal importance so far as public relations and the friendliness of the public are concerned. It is always hard to get anybody to visit the plant. They come down there with a very bad opinion of you and the plant and everything pertaining to the sewage, and anything that you can do to improve that opinion by improving your plant and beautifying it and keeping your trucks and men and everything presentable, I think, has an important effect.

Besides discussing questions of this kind here, I think they should also be discussed before your chamber of commerce and your service clubs, because that is where you get more reaction than any other place.

MR. RUDOLPH (Sonoma State Hospital) (by letter): The newer Sewage Plants are built on a modern and up to the minute design, and are so laid out, that good landscaping is one of the essentials of good plant operation.

I realize that landscaping a Sewage Treatment Plant from the beginning, will take considerable time and effort on part of the operator. To begin with the Operator should study the natural contours of the ground that the plant is built upon.

First of all, grading, sloping, and shaping for drainage, should be given careful consideration. Lawns or grasses look good, and do grow well with little care on low flat areas, but are hard to take care of on slopes and embankments. Small hardy shrubs and vines are the best for slopes and terraces, as they soon cover in a short time.

Natural stone can be used for retaining walls of flowers and shrubs, and it does give an attractive appearance. Sturdy evergreen trees and shrubs, requiring the minimum of care, should be planted. Your local nurseryman can give you a good many helpful pointers. When you plant flowers and shrubs along your walkways and driveways, do so, so as not to interfere with the movement of your operations.

In fact anything that the operator can do to help beautify his plant and grounds would not only be appreciated by the operator, but by the community which he serves.

MR. WALKER: Our plant is about four hundred feet from the road. Along both sides of the road I planted roses and red berries. Around the tanks about a foot and a half I put a little flower bed, in which I grow verbina and coxcomb. Then I put in a lawn about thirty-five feet by eighty.

On the outside of the administration building I put in climbing roses. At the end of our driveway,—that is back of our building,—

in a big circle. I put flower beds there with about fifteen English holly bushes and different kinds of red berries. In front of that I have a flower bed where I raise gladiolas and iris and marigolds and dahlias. I am alternating now by putting in winter stocks.

I made my own grinder and I trade fertilizer for plants.

I am glad to say that the people that were objecting now come down to our plant and say we have a park here, and ask for cut flowers.

MR. STRANGARD: I think this whole subject was covered thoroughly in the 1937 or 1939 short course at the University of California. They had a whole chapter devoted to the beautification of grounds. The ice plant covers very rapidly and stops soil erosion, and it is a wonderful blooming mat, like they had over at the Exposition during the fair. They had a magic carpet.

MR. JONES: I have found in Stockton sixty cents' worth of petunia seeds of different colors planted in a box, and then taken and set out on the sides of the levees, makes a beautiful sight in the summer when they all get to blooming. It makes a cheap cover and is pretty. Canna lilies are always pretty and are easy to care for.

MR. CLARK (Mare Island): I found several years ago that the man on the second shift, that is between four and midnight, had a greatdeal of time at his disposal, particularly after eight o'clock. He would rush through his work, and then about all he would have to do was rake the screens. We were able to utilize the four-to-twelve shift as a gardening shift. One of the operators was interested in gardening. In fact, he was operating a nursery in the community. I have heard, since I have left there and this man took over that it is now more of a park than it is sewage-treatment plant. But at that time we kept all of the city offices supplied during the summer time with fresh flowers. The city of Medford operates its own airport.

MR. PARKS (Los Angeles): Mr. Clark's remarks remind me of two plants, one particularly: the Terminal Island plant at the city of Los Angeles; and the other one in the city of San Fernando. Their beautification required different treatment.

At Terminal Island we are fortunate in having sufficient appropriations for a good-sized staff of men. But we have endeavored to beautify that plant. There is altogether, I think, about three and a half acres in the site, and of that about an acre is in lawn. It grows pretty fast. It is sand all fertilized with sludge. and we raised perfectly gorgeous zinnias and marigolds. We would take them up to the City Engineer's office. But we have found that it takes practically one man's time to take care of all of that area. That is a lot of lawn to mow. We have a power lawnmower. And the trees need pruning, and the flowers have to be cut and taken care of. Recently we have had quite a lot of construction work. During that time the grounds have had to be neglected.

San Fernando is a small residential community in the northwest corner of the metropolitan area of Los Angeles. It has a small plant,

located out in a wash, a mile from the center of the community. In that particular area there is a good bit of cactus and brush.

The grounds are fenced and the operator, a very reliable Mexican, spends about five or six hours a day with little planting—a few oleander bushes and pepper trees. There is no effort in keeping flowers and lawns, and there is not a weed inside that fence.

MR. WOODWARD (Laguna Beach): Last year our city acquired some thirty acres for a park just across the street from our plant, which is going to be beautified. Now you can imagine what it will mean to our plant there. We are going to have to do some more beautifying to keep up with that. We have a good start, but it is a lot of work.

One of our biggest problems is the forty-eight foot tower, and about twice a year it has to be trimmed to keep it looking like anything. We have some power clippers we use and a long pole and ladders, and we also have to put planking up around the top.

I am no gardener but both of my assistants are good, and we have carried it on by ourselves so far. But with this park next to us, we hope that the gardeners that take care of it will just step across the way and take care of ours!

Paints

MR. BENAS. I believe in colors for disposal plants—different ones, depending upon the various services—for instance, water pipes can be painted blue, and pipes that carry other liquids painted green, and chlorine gas pipes painted yellow, the sludge lines brown, and sewage lines black. We try to paint all our machinery a machinery grey instead of black. Painting has been very effective. People who come into the building are inclined to remark upon the appearance.

We originally had all our railings black, and we found that they were hard to maintain, getting greasy and dirty. We have certainly improved the appearance of the plant. I believe in bright colors and variations in the plants. Floors, of course, are hard to maintain.

Of course, the difficulty with all these paints is that you have to let them dry so long before you can use them. If you can find something that will give a hard finish on top of the floor and is easily cleaned and has a reasonable wearing life and would be quick drying, that would be the answer to that.

MR. JONES: In Stockton we have trouble getting paint late in the year. So the street department uses a traffic lacquer. It is a white, and they use a black lacquer and make a grey out of it. We can get all that we want without charging it out to the plant. So, we made a grey lacquer paint—and it has several advantages, you can walk on it in five minutes. We use on top of that a liquid wax to help preserve the finish. However, six months is a long time for its life. We had better luck with it than we did with the floor enamels.

MR. HOSKINSON (Sacramento): We have found that the most satisfactory paints are the synthetic enamels. They come in about any color a person would want. It is very effective on metal.

They are not expensive to apply, and dry quite rapidly. It runs about a dollar a gallon cheaper than some of the other enamels.

MR. BENAS: We had a lot of trouble with our walls at first. We tried the same enamel paint, and since then we can wash the walls and have no trouble whatsoever.

MR. CLARK: I would like to know if any of you have had any success with the use of sodium triphosphate to clean your metal surfaces for painting. A solution of hot sodium triphosphate was suggested to me at one time by a representative of **Greeley & Hanson** at the Medford sewage-treatment plant. I have found it much superior to gasoline or any of the petroleum products for cleaning off sewage film. It is a great labor saver. It is the best thing for cleaning out a garbage pail.

MR. ALLEN: I think that oakite is the same thing.

MR. VAN NORMAN: Naturally the best result would be to have the material painted before you bring it into the plant. Of course, that does not apply where you are repainting. My experience has been that you cannot use any lead or linseed oil; it will turn black overnight. We have now a paint that comes in beige, red and grey. Aluminum will be unobtainable from now on, I understand. I just changed to a grey paint which is non-corrosive—but the Government has requisitioned all that.

Odor Control

MR. GILKEY (Roseville): The question of odor control, I think, depends entirely on the operator. Basins and pools, if you have any open ones like we have up there must be kept clean around the edges.

Visitors at the plant sometimes make a fellow notice something that has been bothering right along but he never noticed it.

Another problem that few of you have, I imagine, are uncovered or partially covered digester tanks. Ordinarily we have no trouble from them, except perhaps in the still heavy night. But whenever they start **riling** up, perhaps a couple of times a year, it is quite a problem. The tank holds about eighty thousand gallons, and I find that one thousand to fifteen hundred pounds of hydrated lime will stop that in a couple of days. At least, it stops the odor, which is not a hydrogen sulphide odor; but just a combination of objectionable odors.

At our plant I can apply chlorine at three different points, ahead of the bar screen where the fresh sewage comes in, and then in the first **vat** of my clarifier, and then in the effluent chute. I think that that chlorine does more than anything else to keep down that fresh sewage odor.

I don't believe the chlorine does a great deal of good in the first **vat** because there is so much heavy concentrated material there it will not show through the clarifier unless I give it sixty pounds to a million gallons of flow.

The chlorine does quite a good job in the effluent flume and the retention basin. I put it there going into the creek.

As far as the rest of the odor control is concerned, you just simply

cannot pile rags out in the open. They must be cleaned up every day and either buried or burned.

When we first started, we tried cleaning those screens with rakes and taking everything we got out and burying it in pits. We have found out now, by washing it through and keeping the screens free from such things as cellophane and large rags and roots, that we do not have hardly any of it, except in the winter-time, when a sort of fungus gets in.

MR. WOODWARD (Laguna Beach): The Laguna Beach Sewage Treatment Plant is located five blocks from the business district of Laguna Beach and only one block from the City Hall, therefore, one of the problems we have to continually consider is the proper control of odors in our plant operation. In every case when we have had trouble due to odors at our plant we have found that the best solution of the problem is to prevent the occurrence of odors in the first place, therefore, I have come to the conclusion that "odor prevention" is a better term than "odor control."

At the Sewage Works Convention held in Santa Cruz Mr. Bowlus of Los Angeles presented a paper on sulphide control in the sewer mains in which he reported that they were able to eliminate all hydrogen sulphide odors at various points in their system. I believe that this is the place to start if you desire to eliminate odors around the treatment plant, because if you can bring the sewage through the mains to the plant in a relatively fresh condition you have eliminated the source of a great many plant odors right at the beginning. This is born out by the fact that in our experience in the Laguna Beach Plant we have found that we must be particularly attentive to the primary clarifier in order to reduce odors to a minimum. We have had good success in controlling the odors arising from the primary clarifier by treating the incoming sewage with chlorine. We make regular tests on the primary effluent for sulphides and then feed just enough chlorine to eliminate them. Incidentally, we have found that by making a few slight changes to the primary tank and securing a better sludge pumping system the quantity of chlorine could be reduced.

We had trouble for a period of time due to odors from our digester. In tests taken at this time we found sulphides as high as 26 p.p.m. We tried treating with chlorine, various ideas of ventilation, and everything else. The heating coils in our digester had corroded to such an extent that they had failed and we were unable to keep the sludge in the digester heated. We decided to empty the digester and install a new verticle hot water circulating system a year and a half ago, and have found that since rebuilding the digester we have no odors from this source. We have been using a small amount of chlorine in the supernatant discharge line as an extra safeguard and have been unable to perceive any of the typical hydrogen sulphide odors.

I believe that if a plant is kept clean and all units are working efficiently, good ventilation will take care of the balance of the odors, at least we have found this to be true at our plant. We are very fortunate, however, in having a good force draft ventilating system. A 24-inch chimney located 206 feet above the plant on the hill is so placed that breezes from the ocean and canyon on the north carry all odors away

from the town. All of the air from the plant is forced through an air duct to this chimney. This air duct is equipped with a high pressure pump and a spray nozzle arranged to pump chlorinated water across the air duct. This equipment has been used very little because we have been successful to date in controlling our odors in other ways. However, in tests, this equipment has proven quite effective.

As I indicated at the beginning, I believe more work should be done on the construction and maintenance of the sewer mains and more thought given in plant construction, looking towards the prevention of odors rather than allowing them to occur and then attempt to prevent a nuisance by trying to control these odors.

MR. WHITE: I wish to emphasize a few of the points that were brought out by Mr. Woodward and Mr. Gilkey, and I also wish to make a comment that my observations are general, and also that I recognize the various types of odors that occur in plants, and will confine my comments only to the sulphurous and hydrogen sulphide odors.

These odors can be associated with the strength of the sewage, the sulphate content of the water which is contributary to the sewage in the system, and to the sewage in the system, and to the local temperature conditions, the rate of change of these temperatures, and also to the design of the collection system itself. As to the control of these odors, there are many things that can be done.

First of all, we might list them in the order in which the operator might attempt to practically solve the odor-control problem. As Mr. Gilkey and Mr. Woodward have pointed out, good housekeeping is essential,—the prevention of the accumulation of solids that may occur in your collection system. In this connection the operator can control his rate of flow in the system to increase the velocity and prevent this accumulation.

We would also attempt to control the sulphate-splitting organisms by chlorination. There is also pre-chlorination and the Scott-Darcy method of chlorination; and the chemical reaction between the various sulphides and metals, such as iron, copper and zinc. Then, too, there would be the p-H adjustment, aeration of your structures, or the use of evaporating mechanisms.

MR. FRASCHINA: In our plant we use essentially the same methods of odor control as have been indicated so far. Our primary method of control is pre-chlorination. We pre-chlorinate at the rate of thirty pounds per million gallons. In our case we are particularly fortunate in having fresh sewage. In addition, the tanks are all housed, preventing the odor from dissemination in the park.

We are in much the same position as Mr. Woodward in that we have to maintain odors at a minimum.

We remove grease by aeration; and that aeration, incidentally, helps to improve the dissolved oxygen content of the sewage, so that we rarely have any trouble from odors in the sewage itself. The only odors that we do get within the buildings are those due to the fresh sewage: the usual ammoniacal odors.

In our sludge-control house, vacuum filter room, and elutriation tanks we have draft ventilation. The suction of air forced up through the roof.

Another thing that we have been forced to do because of the amount of sand that comes into the plant, was to clean out our mixing and sedimentation tanks periodically; and that usually occurs only in the wintertime when the plant is bypassed anyhow. But the accumulation of sand exposed to the air does give off considerable odor, largely due to organic acids and some hydrogen sulphide. The best thing that we have found to control this is to keep the sand covered with water.

MR. JONES: One thing that interests me is how long these flues and blowers will last.

MR. BENAS: We use a blower, and find that for ventilation, in most cases we just blow fresh air in rather than suck it out. When you blow fresh air in you lower the humidity.

MR. POMEROY (Consultant Chemist, Pasadena): Hydrogen sulphide gas is, of course, heavier than air. But in the condition where you have very offensive odors, you may have at most perhaps a hundred parts per million—two hundred parts per million of hydrogen sulphide. That would be near saturation. It would have a negligible effect on the density of the air. The thing that will determine whether the odors will rise or settle will be the temperature of the air more than anything else. If the air is warmer than the surrounding air, they will rise; if it is cooler than the surrounding air, it will tend to lay in the bottom of your sump. The density of the hydrogen sulphide will have nothing to do with it. Humidity enters into it to some extent also. Water vapor is lighter than air, and so humid air, provided it does not actually have a fog in it, will tend to rise rather than settle.

MR. PALMER (L. A. County Sanitation Dists.): Our actual experience in ventilation at Los Angeles is that it is advisable to draw the air from above. At the same time, there is a possibility of a little odor accumulating just under the ceiling, so we make the largest opening at the bottom of the flue but somewhat smaller than the flue itself, so that there will be a little suction. Then we have another hole just below the floor which sucks out a little bit there. This works very well.

A GENTLEMAN: We had considerable trouble with ventilators, made of galvanized iron, and we painted them about every six months, but it did not do any good. In about two years they were eaten up, so we made them out of copper, and find they are lasting quite well.

MR. PARKES: In our plant we were asked to control the odors, and decided that one of the places from which odors were coming was the trough around our circular clarifier where the sewage was spilling over. It was also considered that quite a bit was coming from the bar-screen where the sewage first enters the plant.

Wooden covers were fitted over these chambers, and also over the overflow box on the digester. We put burners around, on the assumption that the burners would heat the air and cause a certain amount of draft. We were horrified later to discover that apparently we had trapped the odors and kept them from circulating to the atmosphere. The concrete was eaten into at several places as much as an inch and a half.

When these covers were removed, we found in some cases where the planks fitted together very closly there was very little attack on the

concrete. Where there were cracks, however, between the planks, there were streaks where the concrete had actually been eaten away under these cracks.

The suggestion I have to offer is to ventilate, by all means, but if you are going to ventilate, ventilate plenty.

MR. POMEROY: The conversion of hydrogen sulphide to sulphuric acid, which of course is the reason for the corrosion of the concrete, as you all know, takes place down to extremely low concentrations of hydrogen sulphide, provided the bacteria which bring about that change are present.

Fred Bowlus and I, for example, made experiments in the outfall of the Los Angeles County sanitation districts in which there was an atmosphere containing twenty or thirty parts per million of hydrogen sulphide, and we stopped the evolution of hydrogen sulphide from the sewage by stopping the flow of the sewage, because only when there is turbulence is there any hydrogen sulphide evolved. Then we watched the concentration of hydrogen sulphide . It went down rapidly to zero, especially near the walls where the change was taking place. That shows that extremely low concentrations will be converted to sulphuric acid by these bacteria,—a concentration as low as one part per million, undoubtedly.

The theory of ventilation, as practiced by the City of Los Angeles, I believe (I have gathered this from a conversation with Mr. Parkes and others), is at least in part one of drying the surface of the concrete, thereby creating an environment in which the bacteria will not work, because we know that if the surface is perfectly dry you will not have that change taking place. So, that at least is one important factor.

A further thing in support of that is this fact: The air which is exhausted from the north outflow of the City of Los Angeles contains (I have forgotten the figures) a considerable concentration of hydrogen sulphide,—a concentration which would be high enough to cause a significant attack on the concrete if there is enough moisture on the walls so that it is being converted into sulphuric acid.

As to this phenomena that you mentioned at the Terminal Island plant, of greater attack near the cracks where there was more air coming in, I haven't had an opportunity to examine that and would hesitate to express an opinion offhand as to why that should occur. But you raised the question of whether it may have needed more oxygen than was present. There is evidence that the change also takes place at very low oxygen concentrations. For example, in the north outflow sewer in the City of Los Angeles, that was originally operated on the theory that if they shut it up tight and kept the air out they would not have any attack; but experience indicated that in spite of the attempt to shut it up tight there was enough oxygen in there so that the bacteria seemed to do very nicely.

Of course, this is getting away from the odor-control problem, but I do certainly subscribe to what Mr. Parkes said: that if you are going to ventilate, especially a sewer, or cover over a flume or some other place where the sewage is flowing, be sure that you ventilate plenty, because it takes a lot of change of air to either dilute the hydrogen

sulphide very much or to dilute the humidity so that the walls will dry out.

A GENTLEMAN: How much is a lot of air, Doctor Pomeroy?

MR. POMEROY: Well, if you are going to ventilate three miles of ten-foot sewer, you have to pull all the air you can possibly pull through it. The power requirement goes up as the fifth power of the length of the sewer that you are ventilating. Suppose it takes ten horsepower to ventilate one mile; to ventilate two miles will take six hundred and forty horsepower to do the same job; because as you try to pull for a longer distance, the attempt to dry out the surface requires a much higher velocity, and the power goes up by the square of the velocity. So, it requires a tremendous amount of air to ventilate a long distance. Furthermore, the distance which you can effectively ventilate is proportional to the diameter of the sewer. When you get down to a small sewer, I don't think you have any possible hope of effecting the control of corrosion for a distance as long as three miles. I think you would have to come down to shorter distances than that to accomplish very much in the way of control, although your sucking air out of the sewer would accomplish other benefits in that it would prevent gases from the sewer going out of manholes and going into house plumbing or going out of house stacks.

Safety Measures

MR. BENAS: The other night, Mr. Knox, Secretary of the Navy, gave a statement before the Safety Congress, in which he stated that there were four times as many man-days lost during the past year by accidents or by loss of time due to safety than there were by strikes, which is really a startling statement. I think he mentioned some figures in the neighborhood of twenty-six million man-days lost through industrial accidents, probably including in that scope some losses due to colds or other sicknesses which might have been caused by working conditions. So that the subject of safety is really an important one.

There are two types of safety in a plant: that type of safety which you do to protect the workmen by means of guards, et cetera: and personal safety, in which you have no control, other than the care of the operator.

For personal safety, in order to reduce that accident, we put up a warning sign at those places or locations where there may be accidents. We provide gloves, gas masks, goggles, boots and coats to keep the men dry and protect their hands and their face and their body from injuries. We have available water and soap so that the men can wash their hands and thereby remove any source of contamination through cuts or bruises.

We provide first-aid kits at reasonable locations. We also have two men working at any place where there is liable to be accidents, and we also give them instructions so that the individual knows his job and knows what he is supposed to do and knows the risks before he does it. This is particularly true in the handling of chlorine.

Most people who have worked around a plant for a long time lose sight of the possibility; they have not been hurt before, and they handle chloride with their bare hands at times and take a chance of having it

squirt into their eyes and getting it on their body, which might result in considerable personal injuries. So, we are pretty careful in those cases to not allow the man to do any type of dangerous job or take any risks to himself or to anybody else, and in that way we cut down injuries pretty well to the minimum.

There have been a number of accidents at the plant which have resulted in personal injury. In one case there was a man letting a manhole cover slip, thereby fracturing his toe. He had to lose part of his toe and will probably be out of work for a couple of months. We had another case where a man was turning on water in a hose and another man not holding the hose tightly, and the hose whipping around, which caused a cut, and there are bruises from handling tools. All those injuries probably could have been averted if the operator had taken sufficient care and sufficient time and thought first before he did the job, avoiding the possibility of injury.

There is one other point of injury which is more or less of a point from plant operation. When a man is injured and when he has to go away from work, that cuts down the efficiency of your plant, because you have to put somebody else in to take his place, and in most cases on short notice. The man who takes his place is probably not as well equipped to do the job as the man who is away from the job. In smaller plants that would probably be more important. In some of the towns that have one operator, it might be practically impossible to get anybody to take the place of the man that is off. In a larger plant it is not quite so hard because you can go to the union or you can go to some other sources and get the man. But in any case, the efficiency of the plant is cut down, because in practically no case is the man who does the relief job as well equipped to do the job as the man who has worked there.

So, for those considerations, I say that personal safety is an important thing, and that everybody and every person who has anything to do with plant operation should take every care possible, not only in doing the job himself, but to inspect those who work with him, so that the accidents are cut down to a minimum.

MR. SCHUCK (Burlingame): When we first started our plant about five years ago, we found our gas holder would not rise with the pressure. The seal would keep blowing. It was necessary to get inside the gas holder and burn off some steel railroad rails that were in there, put in for weight. They had to be cut off with an acetylene torch. This would be a dangerous job. In order to get the gas out and to make it safe, we took the manhole plate off and filled the tank to the top of the seal with water, and let it out twice. Air from an air compressor was pumped into the tank for about five hours. We then had the gas company test for gas, and it was found to be okay. We went inside the tank and cut the rails out with an acetylene torch, after which we put the holder back into operation.

In another instance, in starting our sewage-disposal plant, we had a serious accident to the digester tank. One morning, about five months after we started the operation, I found the top of the digester tank cracked, the crack running all around the gas dome; and several cracks ran from there toward the outside of the top. Part of the rim

portion still was exposed, and the gas was coming through the cracks, but the seal had not blown.

The apparent reason the seal had not blown was the fact that the mat on top of the liquid sludge had pressed so hard against the bottom of the gas dome that it had shut off the gas and seal, causing an excess pressure in the digester tank, which caused the whole top of the tank to rise in the center and drop back into place again, this mat keeping the seal from blowing until the gas had escaped through the cracks to relieve the pressure. Then the mat lowered and the gas could escape through the seal, which caused the seal to blow.

The next day we took the manhole cover off the gas dome and found that the mat had pressed so hard that it made a regular shape like a hat.

This accident, I think, would happen very rarely, and then only in starting a new plant. But it was expensive and might have caused injury to our employees. The remedy might be to leave the manhole cover off the gas dome and agitate with fire hose until the plant is in working operation.

MR. WOODWARD: I have found that when we are working the plant at night, we go there the first thing in the morning; that is the time to check the vents. Every one of my men is instructed to do that. If they notice anything unusual whatever, they commence to check up. If we do not find it we take the gas detector and make tests until we do locate it, and that thing is repaired and fixed right then before it goes any farther.

As a rule, safety in the plant has not been given the consideration it should have either by the plant operators or the plant designers.

Many plants are constructed with chlorine tanks in the pits, gas pockets and pipe galleries. They should be well ventilated.

Every operator should know all the hazardous points in his plant and should give them a systematic inspection regularly, to see that all valves, flame traps and electrical equipment are in working order at all times. All doors in the plant should open from the outside so that it can be ventilated before entering if necessary.

All operators should know how to use a gas mask. A canister mask should never be used on sewer gas. All gasses of this nature require an open air mask where fresh air is fed through a hose to the outside, or with the use of a blower. All masks and first aid equipment should be kept in a central place. At least two operators should have first aid training and know what to do in any emergency. Make a plan of what might happen and be prepared as much as possible.

Do not let your work become so much routine that you become careless, as most accidents happen this way. Operators should figure every way to prevent accidents and a little more care taken on the job might save a life. After all, safety first is worth more than all you can learn about first aid.

Sampling Methods

MR. TENNANT (L. A. County Sanit. Dist.): Samples, of course, should be honestly taken. It does not matter whether you show a good or bad result, as long as you show the real result. The sampling schedule, of course, should be fixed to show the mean average of what you are trying to determine.

Take the sampling of a digester, for instance, if you are sampling for sand, that is one thing; if you are sampling for water, it is another; or sampling sludge for a determination of the reduction in the volatile solids. The sampling of the raw sewage, of course, is very difficult to do because you may get a little more solids in one sample than in another. Sampling of the sewage should always be prorated according to the flow, so that throughout the twenty-four hours you have a true composite of the amount that passed the plant. If you sample oils, you use one method; if you sample gases, you use another.

We take our fresh sewage samples by having a calibrated test tube according to the pump combination which we may be using at that time. Of course, all of our sewage is pumped. The operators once an hour fill the test tube up to the pump combination they are using at that time. And at the end of the twenty-four hours the samples are taken to the laboratory and shaken up and analyzed for whatever the laboratory may wish to find out.

MR. GILKEY: If I pump for, say, twenty-five minutes on my clarifier into the digester; what is the proper procedure to get the amount of solids that is pumped?

MR. TENNANT: If you want a sample of that pumping for a determination of the solids, you should pump long enough to clear the line before you start to sample at all. In pumping twenty-five minutes, I would suggest that you take about three samples—not over three. Of course, the point of sampling, too, is very important, that you get one representative of what you are after.

MR. GILKEY: What I had in mind was that when you start pumping it is quite thick, but when you quit it is almost—not quite clear. I just wondered how you would get the amount that you pumped.

MR. TENNANT: Well, your pump would be discharging the same flow continually throughout the pumping, I take it? Then you should sample often enough to get a representative amount of thick compared to the thin. Another way you could determine that; if you started with three samples throughout your pumping period and ran whatever you wished to run on that, check that against more frequent sampling and see whether you get the answer. If you get the same answer with more frequent sampling, then you are getting a representative sample.

A GENTLEMAN: About how big is that calibrated test tube? What is the capacity?

MR. TENNANT: About 150 cc's, calibrated at different points.

MR. JONES: Mr. Tennant, do you take a composite of samples from your inflow?

MR. TENNANT: We have a rather unique setup in our plant. All of our sludge is pumped to a collection tank. Then it is automatically composited and measured—we use this collection tank as the measuring vessel to charge the digester. We take the samples from this collection tank at various levels over various places in the tank. We have determined the place where we get the best representative sample. Then we take the top, middle and the bottom, and mix those three; that is the composite of the collection tank. This tank into which our raw sludge is pumped performs a good many functions: it measures

our sludge; it gives us a visual observation of the character of the sludge that we are pumping; it permits us to charge the digester at a regular rate. Up to the time the plant was rebuilt and put into service about six months ago, we pumped our sludge, as many of you do, through an invisible pipe line. We hoped that it started with the moisture content we desired and that it arrived at the digester in something like the quantity that we had guessed at. This new arrangement is positive and a nice setup. The sludge is pumped from eight standard rectangular tanks. We have variable-speed motors, and pneumatic controlled valves from the eight tanks. As the sludge passes from the pump house to the collection tanks it passes over the sewage-discharge channel. If it does not happen to be of a character that we want to collect, we simply open a quick-opening valve and shoot it back into the discharge channel, and it goes through the system again. When it thickens up we open a valve and shoot it over into the collection tank. We collect about twenty-five thousand gallons twice a shift.

A GENTLEMAN: Do you decant that then?

MR. TENNANT: Oh, it isn't necessary to decant it. In fact, we have to thicken it sometimes to pump it into the digester. It is a splendid arrangement when it comes to thickening up, because we can run the sludge through the system twice if we want to. We were a little afraid of odors at first, but we have not experienced any—no more than you would expect. We are fortunate, however, in that we received quite a large amount of iron in the sewage. Another advantage of those tanks is that we can separate the sand. In our system sand is bad. We have a ten-acre-foot lagoon close to the plant, and when the sand arrives in large quantities, we can pump off enough of the lighter material which forms a cone down through the sand and discharge that to the digester to maintain our gas supply. As we pull out the bottom of the tank we throw that over into the open lagoon, and that saves putting sand through the digester.

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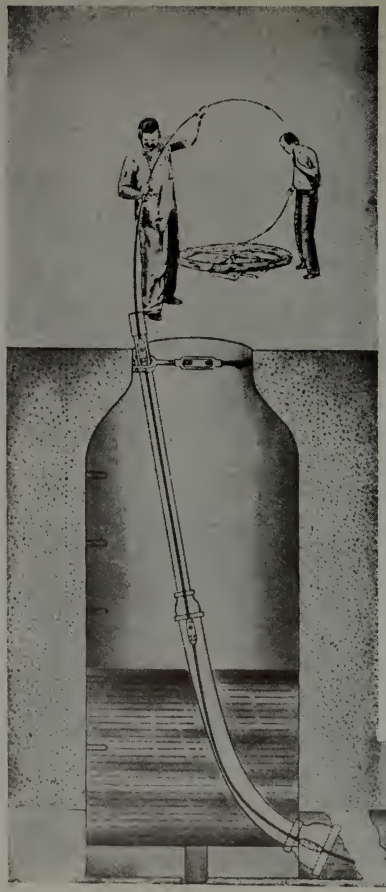

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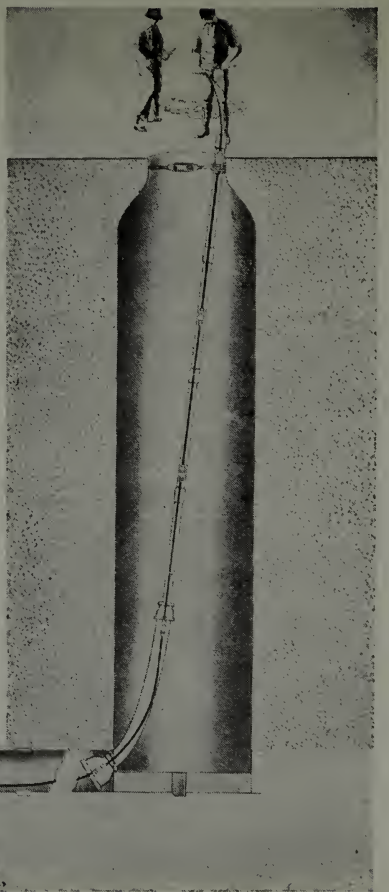

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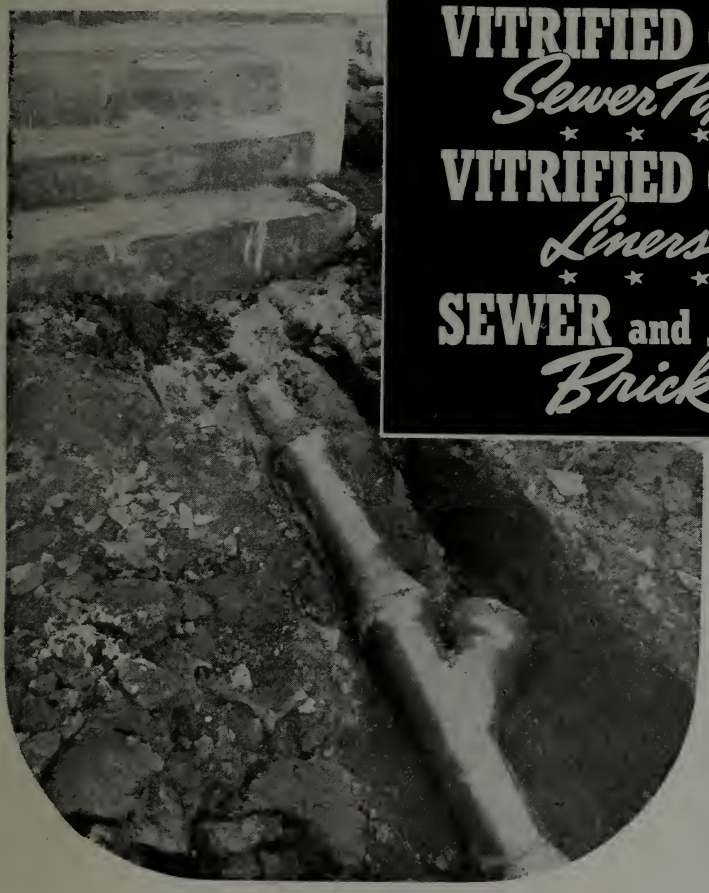

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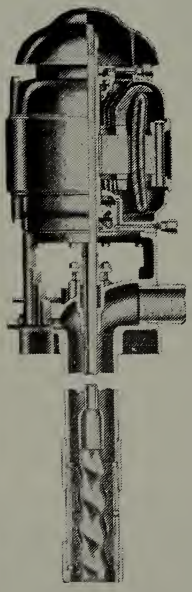

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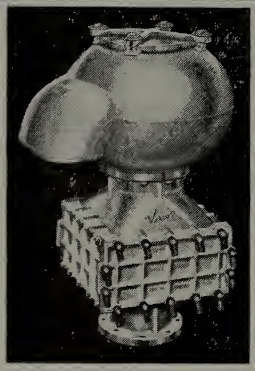

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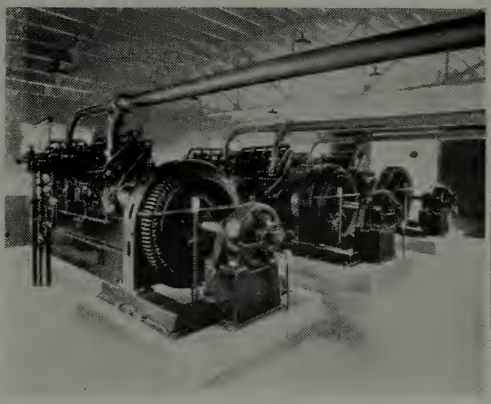

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A typical 5000-man complete sewage treatment plant, Dorr Clarigester to the left; Dorrco Distributor in center; sludge drying beds in rear.

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For Primary Treatment:

A Dorr Clarifier for the primary sedimentation

A Barnes-Dorrco Pump for controlling clarifier operation

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A Dorr Multdigestion System for the efficient two-stage reduction of sewage solids

Or

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Camp Edwards, Mass.
Camp Shelby, Miss.
Camp Beauregard, La.
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In the early days of the National Defense Program we made a study of the sewage and water treatment requirements of modern army camps and air bases.

Today, accurate design and specifications are set up for Dorr-equipped plants—providing all types of treatment for camps ranging from 1000 to 60,000 men.

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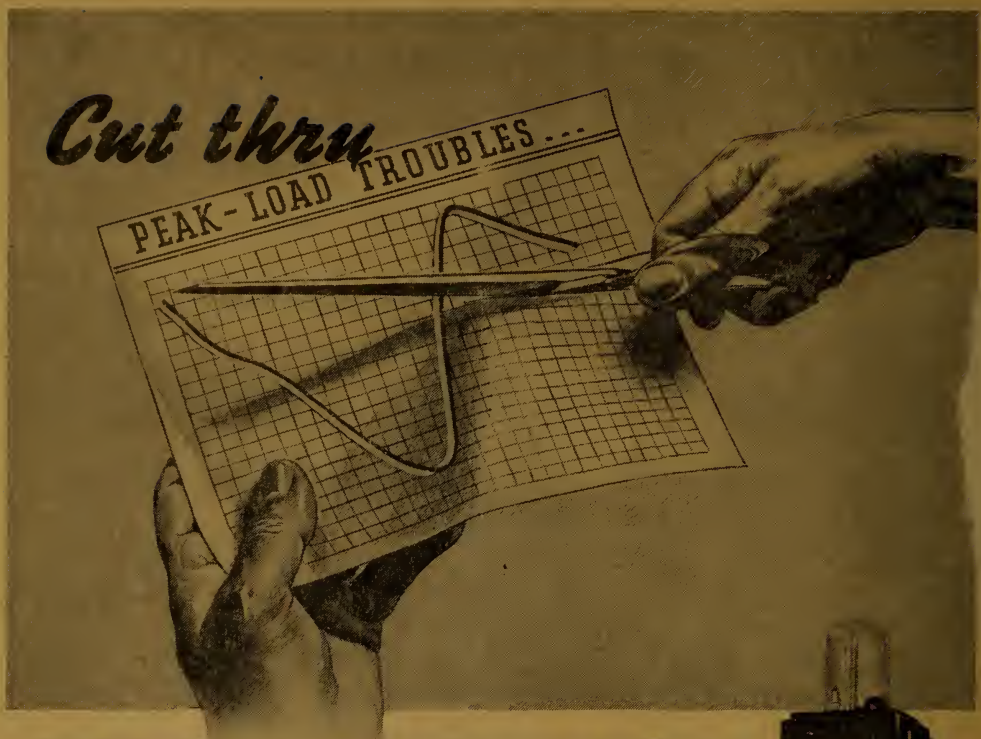

WITH PREVENTIVE CHLORINATION

Are these days of shifting population and increased industrial activity putting an excessive load on your sewage plant? Has the reserve capacity of your plant been taken up by increased demands, leaving you vulnerable to peak loads and unfavorable climatic conditions? Are sedimentation tanks, filters or other equipment so loaded that a sudden call for capacity operation would create an operating emergency?

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